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Atlas of Topographical and Applied Human Anatomy

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Table of Contents

The Head

The Skull

	Figs
Points for skeletal measurements	1
External aspect of head, from behind	2
Adult skull, from the right side	3
Adult skull, from front	
Adult skull, from behind	
Base of skull, from the inside	
Calvaria, from above	
Skull with muscle attachments, from front	
Skull with muscle attachments, from the side	
Base of skull, from below	10
Base of skull with muscle attachments	11
Skull, midsagittal section (left half)	12
Skull, midsagittal section (left half) with muscle attachments	13
Skull, posteroanterior roentgenogram	14
Skull, right lateral roentgenogram	15
Paranasal sinuses I, posteroanterior roentgenogram	16
Paranasal sinuses II, posterior roentgenogram	17
Paranasal sinuses III, axial roentgenogram	18
Head, arterial pattern (semischematic)	19
Head, venous pattern (semischematic)	20
Head, nerve pattern (semischematic)	21
Head, lymphatic pattern (semischematic)	22
External carotid angiography	23
Diploic veins, lateral roentgenogram	24
Diploic veins of the calvaria	25
Newborn skull, from right side	26
Newborn skull, from above	27
Skull of an aged edentulous individual	28
okuli of un aged edentatous marvidual	
Brain and Meninges	
Oura mater in situ, from the side	29
Brain with the arachnoid membrane, from the side	30
Our a mater in situ, from above	31
Brain surface in situ, from above	32
Brain surface in situ, from the side	33
nsula, exposed in situ	34
mount, exposed in situ	

	Figs
Lateral ventricle in situ, from the side	35
Left lateral ventricle	
Brain stem and falx cerebri in situ, lateral view	37
Frontal lobes in situ, from front	
Olfactory bulb and tract in situ, from front	39
Optic nerve and chiasm, from front	40
Suprasellar hypophyseal region, arteries and nerves, from front	41
Lateral ventricle, horizontal section through telencephalon in situ	42
Choroid layer of prosencephalon and tentorium in situ	43
Lateral ventricle in situ, from above	44
Lateral ventricle in situ, from above	45
Basal ganglia and cerebellum in situ, from above	46
Brain stem and basal ganglia in situ, from above	47
Head, median section	48
Head, horizontal section at the level of the external occipital protuberance	49
Occipital region, blood vessels and nerves	50
Dura mater and dural sinuses in situ, from behind	51
Arachnoid and dural sinuses in situ, from behind	52
Brain surface and cerebellomedullary cistern in situ, from behind	53
Cerebellum and roof of the fourth ventricle in situ, from behind	54
Rhomboid fossa in situ, from behind	55
Brain stem and cervical cord in situ, from behind	56
Dura mater, on the base of the skull	57
Brain with arteries and cisterns in situ, from below	58
Brain with arteries and nerves in situ, from below	59
Cerebral arterial circle, inferior surface of brain, in situ	60
Left hemisphere, arteries	61
Cerebrum, medial surface, arteries	62
Upper brainstem, arteries	63
Anteroposterior carotid angiogram	64
Basal vein and great cerebral vein	65
Internal cerebral veins and tributaries	66
Head, venous trunks and dural sinuses, semischematic	67
Anterior, middle, and posterior cerebral arteries in situ,	
horizontal section through the brain	68
Foramina on base of skull with contents, from inside	69
Dura mater and dural sinuses in situ, from inside	70
Arteries of the brain, relationship to base of skull	71
Base of skull and paranasal sinuses	72
Basal vein (of Rosenthal) and its tributaries	73
Lateral carotid angiography	74
Fronto-occipital vertebral angiography	75
Lateral vertebral angiography	76
Superficial veins of brain, lateral phlebogram	77
Trigeminal nerve, intracranial portion in situ, and arterial circle	78
Trigeminal cave (of Meckel) and trigeminal cistern, multi-level sections through	
the base of the skull	79
Facial nerve and tympanic cavity, base of skull from inside	80
Sella turcica with blood vessels and nerves	81
Middle ear region with vessels and nerves	82
Carvolid canal and adjacent region	83
Diencephalon in situ, from above	84

	Figs.
Tentorial notch, from above	85
Arachnoid and subarachnoid space on the base of the brain	86
Arachnoid and subarachnoid space, median section (semischematic)	87
Arachnoid, subarachnoid space and cisterns of the brain, lateral view (semischematic)	88
Surface of cerebral hemispheres after removal of the meninges, from above	89
Cerebral hemispheres after removal of leptomeninx, from above	90
Cerebrum after removal of leptomeninx, from below	91
Cerebrum, midsagittal section	92
Cerebrum, horizontal section viewed from below	93
Basal ganglia of the brain, third ventricle, lamina quadrigemina, and cerebellum,	
from above	94
Brain stem with associated structures, from below	95
Medulla oblongata, rhomboid fossa, and cerebellar peduncles after removal	
of cerebellum, dorsal view	96
Medulla oblongata, pons, mesencephalon, and diencephalon, from below	97
Rhombencephalon and mesencephalon, seen from right side	98
Brain stem and cerebellum, from right side, dissection	
Medulla oblongata, cross section at level of decussation of medial lemniscus	
Medulla oblongata, cross section through lower third of olive	
Medulla oblongata, cross section at the level of the lateral recess of the fourth ventricle	
Pons, cross section through the facial and abducens nuclei	
Midbrain, cross section through the superior colliculi	
Pons, cross section at the level of the trigeminal nerve	
Brain stem, cross section through the inferior colliculi	
Caudate and lentiform nuclei, model of the basal ganglia, lateral view	
Basal ganglia, lateral view, model	
Cerebrum, cross section through the region of the anterior horns	
Brain, frontal section through the anterior commissure	
Brain, frontal section through the boundary between the anterior horn and central part	
of the lateral ventricle	111
Brain, frontal section through the third ventricle	
Brain, frontal section through the third ventricle	
Cerebellar tracts and basal ganglia, fiber preparation	
Radiations of corpus callosum, dissection	
Optic pathway, dissection	
Ansa peduncularis and anterior commissure, dissection	
Fornix and hippocampus, from the side	118
Fornix and dentate gyrus, from below	
Pyramidal tract, dissection	
Corona radiata and internal capsule, dissection	
Superior sagittal sinus and lateral lacunae, frontal section	
Head of a three-week-old child, median section	
Association tracts of the left hemisphere, lateral view, dissection	
Ventricular system, cast	
Cemporal lobe, frontal section	
Lateral ventricle, third ventricle, corpus callosum, fornix, and hypothalamus,	
frontal section at the level of the mammillary bodies	127
Brain stem, midsagittal section	
Ventricular system and its topographical relationships within the brain and	
the bony skull, semischematic	129
Anteroposterior ventriculogram	
Lateral ventriculogram	

	Figs.
Neurocranium in situ, frontal section at the level of the epiphysis and	
the superior colliculi	132
Brodman's cytoarchitectonic cortial areas	
Cytoarchitectonic cortical areas of v. Economo and Koskinas	
Brain stem and cranial nerves, their relationship to base of skull	
Drain stem and cramar nerves, then relationship to base or skull	133
The Face Region	
Mimic musculature, superficial vessels and nerves of face, from front	136
Mimic musculature, from skeletal side	137
Face and scalp, superficial blood vessels and nerves, side view	138
Face region, parotid gland and retromandibular fossa, blood vessels and nerves, lateral view	
Retromandibular fossa and facial nerve	
Retromandibular fossa and jaw joint, vessels, nerves, and muscles of the deep face region	
Infratemporal and retromandibular fossae	
Deep face region, lateral view after resection of the ramus of the mandible	
Infratemporal, retromandibular, and submandibular fossae after removal	
of the right half of the mandible	144
The Visceral Compartments of the Head	
N I D I C	
Nose and Paranasal Sinuses	
Mysacal spaces of the head viscous treat from front comischematic	115
Mucosal spaces of the head visceral tract, from front, semischematic	
Facial skeleton, retrobulbar frontal section	
Facial skeleton, frontal section through mouth and nose regions	
Nose and paranasal sinuses, frontal section through the bones	
Nose and paranasal sinuses, frontal section showing mucosal relationships	
Paranasal sinuses, on the skeleton, lateral view	
Paranasal sinuses, on the skeleton, medial view	
Nasal septum, arteries, and nerves	
Head, median section with blood vessels, nerves, and muscles	
Parapharyngeal vessels, nerves, and muscles at the base of the skull, from behind	154
Pterygopalatine fossa, parapharyngeal space, nasal cavity, blood vessels and nerves,	
medial view	155
Oral Cavity and Teeth	
Vessels and nerves of the oral cavity, from front	156
Sublingual region and pharynx, musculature, lateral view	
Muscles of mastication and oral cavity with muscles, from behind	
Floor of mouth, tongue, vessels, and nerves, cross section at the level of	
the occlusal plane	159
Lingual, sublingual, and submandibular regions, frontal section	
Submandibular and retromandibular regions, transverse section	
	162
	163
Salivary glands, medial view	164
Roof of mouth, mucosal innervation	

	Fig
Floor of oral cavity, mucosal innervation	. 16
Oral cavity, cross section through the facial skeleton at the level of the occlusal plane	
Jaw and deep face region, arteries and nerves, from right side	. 168
Jaw and deep face region, veins and lymphatics, from right side	169
Peripheral taste conduction (semischematic)	
Upper and lower sets of teeth	
Dental root, transverse section through the alveolar process	
Deciduous teeth of a 4- to 5-year-old child	
Deciduous and early permanent teeth of 6-year-old child	
Rows of deciduous and permanent teeth on the right side, vestibular view	
Rows of deciduous and permanent teeth on the right side, oral view	
Roentgenogram of incisors and canines of upper and lower jaws in a	1/(
2½-year-old child	177
Roentgenogram of deciduous molars and developing first permanent molar in a	1//
	170
2½-year-old child	
Roentgenogram of permanent teeth, upper jaw	
Roentgenogram of permanent teeth, lower jaw	180
Ear and Vestibular Apparatus	
Bony framework of the ear and vestibular apparatus	181
Middle ear cavity, projected on lateral surface of skull	
Bony labyrinth, vestibulocochlear, and facial nerves in situ in the petrosal bone	183
Membranous labyrinth with vessels and nerves, schematic representation	
Ear, horizontal section at level of vestibular window	
Mastoid air cells and antrum	
Mastoid antrum with ear and opened facial canal	
Mastoid antrum with ear and opened sigmoid sinus	
Bony labyrinth (cast), posteromedial view	
Bony labyrinth (cast), anterolateral view	
Bony labyrinth (cast), from above	
Fundus of internal acoustic meatus	
Petrosal bone, frontal section	
Middle ear, frontal section	
Middle ear, medial wall	
Middle ear, lateral wall	
Auditory ossicles, disarticulated	
Auditory ossicles, medial view	
Auditory ossicles, from above	
Ear drum, shown translucent, lateral view	
Ear drum with arteries	201
Ear drum, otoscopic view	202
External ear	203
Evo and Orbit	
Eye and Orbit	
Oddiedania	20:
Orbital region, exterior of eye	
Lacrimal ducts	206

Ocular bulb, muscles from above, schematic Ocular bulb, muscles from front Eye and nose region, superficial layer Eye and nose region, deeper layer Eye and nose region, deep layer Ocular bulb in situ, from front Orbit with contents, sagittal section Orbit with contents and pterygopalatine fossa Orbital contents from above after removal of orbital roof. Orbital contents from above after removal of orbital roof and opening the superior orbital fissure Orbital contents from above, branches of the ophthalmic division of trigeminal nerve Ocular bulb, blood vessels, schematic Ocular bulb, exposure of vascular tunic Ocular bulb, pattern of blood vessels in middle layer Ocular bulb, horizontal section Optic nerve, cross section Optic nerve, cross section Optic papilla, horizontal section Anterior part of bulb, horizontal section Ocular bulb, from front Anterior portion of bulb, seen from inside Fundus of the living eye, ophthalmoscopic view Anterior half of eye, from behind Lens and suspensory apparatus, from front	209 210 211 212 213 214 215 216 217 218 220 221 222 223 224 225 226 227 228 229
Neck	
Skeleton, Musculature, and Visceral Compartments	
Skeleton of head and neck, from the side Skeleton of head and neck, from behind Exterior of neck with skeleton and viscera drawn in Craniovertebral joints, from behind Craniovertebral joints, frontal section, dorsal view of cut surface Craniovertebral joints, transverse section at the level of atlas (viewed from above)	233 234 235 236 237 238 239 240 241 242 243 244 245 246

	Fig
Neck, cross section at the level of the 5th cervical vertebra	. 24
Neck, cross section at the level of atlas	. 24
Head-neck region, cross section at the level of oropharynx	. 250
Head-neck region, cross section at the level of nasopharynx	25
Head-neck region, cross section through the oropharyngeal fold	25
Neck, cross section at the level of the 2nd and 3rd cervical vertebrae	. 25
Visceral and neural compartments of the neck, median section	2.54
Neck and facial skeleton, midsagittal section	. 25
Neck musculature, medial view	2.56
Neck and adjoining head region, midsagittal section without the spinal cord	25
Mucosal innervation in head and neck regions, median section	. 258
Topography of Neck Region	
Topography of Neek Region	
Superficial layers of the neck with platysma	259
Superficial layers of the neck after removal of platysma	260
Superficial fasciae of the neck	261
Parotid compartment and related structures	262
Retromandibular fossa	263
Submandibular triangle	264
Submandibular triangle and retromandibular fossa	265
Submandibular triangle and retromandibular fossa	266
Submandibular triangle and retromandibular fossa	267
Carotid triangle	268
Carotid and submandibular triangles	269
Neck, arteries and nerves, from the side	270
Neck, veins, lymph vessels, and lymph nodes, from the side	271
Median neck region and carotid triangle	272
Sternocleidomastoid region and cervical fascia	273
Anterior neck region	274
Thoracic inlet with pleural cupula	275
Thoracic inlet with pleural cupula, multilevel sections	276
Thyroid region, from front	277
Thyroid region and thoracic inlet, from front	278
Thoracic inlet and deep neck region after removal of the manubrium of sternum	
as well as the 1st and 2nd ribs	279
Neurovascular bundles of deep neck region, left side	280
Neck, transverse section through the isthmus of the thyroid gland and the	
7th cervical vertebra	281
Posterior triangle of neck	282
Posterior triangle of neck	283
Posterior triangle of neck	284
Posterior triangle of neck, deep layer	285
Posterior triangle of neck, thoracic inlet, and axilla	286
Posterior neck region, neurovascular bundle	287
Posterior neck region, opened vertebral canal, from behind	288
Suboccipital region, superficial layers	289
Suboccipital region, intrinsic back musculature	290
Suboccipital region, deep layer	291

	Figs.
Vertebral Canal and Spinal Cord	
Cervical vertebral canal, extradural structures	292
Cervical vertebral canal, cross section	293
Cervical vertebral canal, arachnoid sac and adjacent structures	294
Cervical vetebral canal, median section	295
Cervical spinal cord and spinal nerves in situ, from behind (schematic)	290
Vertebral canal and cranial fossa without dura, opened from behind	208
Cerebello-medullary cistern, roentgenogram (air filled)	290
Pharynx and Pharyngeal Region	
Pharynx and neurovascular bundle, from behind, with some of the fasciae	299
Pharynx and neurovascular bundle, from behind, with the internal jugular veins	300
Pharynx, opened from behind	301
Muscles of pharynx and palate, from behind	302
Pharynx and facial skeleton, median section	303
Parapharyngeal structures, medial view	304
Auditory tube and related structures	305
Parapharyngeal region, from behind	306
Deep face region and pterygoid region	307
Cervical neurovascular stalk (lateral) and branching of mandibular nerve	308
Cervical neurovascular stalk (lateral) with lateral pharyngeal wall	309
Cervical neurovascular stalk (lateral) with sublingual region	310
Oral cavity, from front, and arteries of the palatine tonsils	
Pharynx and facial skeleton (midsagittal plane) with tubal and sublingual regions	312
Larynx	
Larynx and pharynx, mucosa and tonsils (semischematic)	313
Laryngeal entrance and portions of pharynx (semischematic)	314
Pharyngeal musculature and part of the piriform recess	315
Back side of larynx and root of tongue with nerves and vessels	316
Submandibular region and larynx, lateral view	317
Submandibular region and larynx without lamina of thyroid cartilage, lateral view	318
Laryngeal musculature, from behind	319
Laryngeal musculature, obliquely from behind	320
Laryngeal musculature of opened larynx, from inside	321
Larynx, from behind	
Larynx, from the side	
Larynx, median section	324
Larynx and root of tongue, median section	
Larynx, frontal section	327
Larynx and pharynx, cross section at level of vocal fold	328
Rima glottidis and laryngoscopic view	329
Neck, cross section at level of glottis	330
Joints of laryngeal cartilages, semischematic	331
Rima glottidis, cartilage, and musculature in various functional states	332

	Figs.
Laryngeal muscles and their actions, semischematic	333
Larynx, lateral roentgenogram	334
Alimentary and respiratory tracts in median section, semischematic	335
Larynx, anteroposterior tomogram during pronounciation of the vowel "U"	336
Larynx, anteroposterior tomogram during normal respiration	337
Larynx, anteroposterior tomogram during deep respiration	338
Digestive and respiratory tracts during eating and breathing, semischematic	339

Index

Preface

The first edition of this atlas which appeared in 1963/64 in German, English, Italian and Japanese was received with great enthusiasm because of its high quality from scientific and technical viewpoints.

With a view toward the needs of the surgical specialties this edition represents a continuing effort to complement the illustrative material from the original drawings by Pernkopf and his collaborating artists with new color plates as well as new roentgenograms which reflect new techniques and requirements in modern medicine. To this end, Dr. Lothar Wicke of Vienna has supplied most of the roentgenograms. The formulation of new short and precise captions was an important prerequisite for translation into other languages. From a technical viewpoint, the editor and publisher have gone to the trouble of making further improvements, such as significantly decreasing

the number of reference lines on the color plates in order to improve "readability," reproducing two-page drawings, which were severely impaired by the center crease, in a reduced single-page format, and reorienting the horizontally wide plates so as to conform to the vertical configuration of the page wherever this was possible without impairment of quality, etc.

The nomenclature used is based on *Nomina Anatomica* (Oxford, Paris, New York, Wiesbaden) with a few exceptions where the term did not seem acceptable to the editor (e.g. Esophagus instead of Oesophagus). For anatomical structures not listed in the *Nomina* the Latin names used by Pernkopf were employed.

Fall 1979

Helmut Ferner

The Head

The Skull

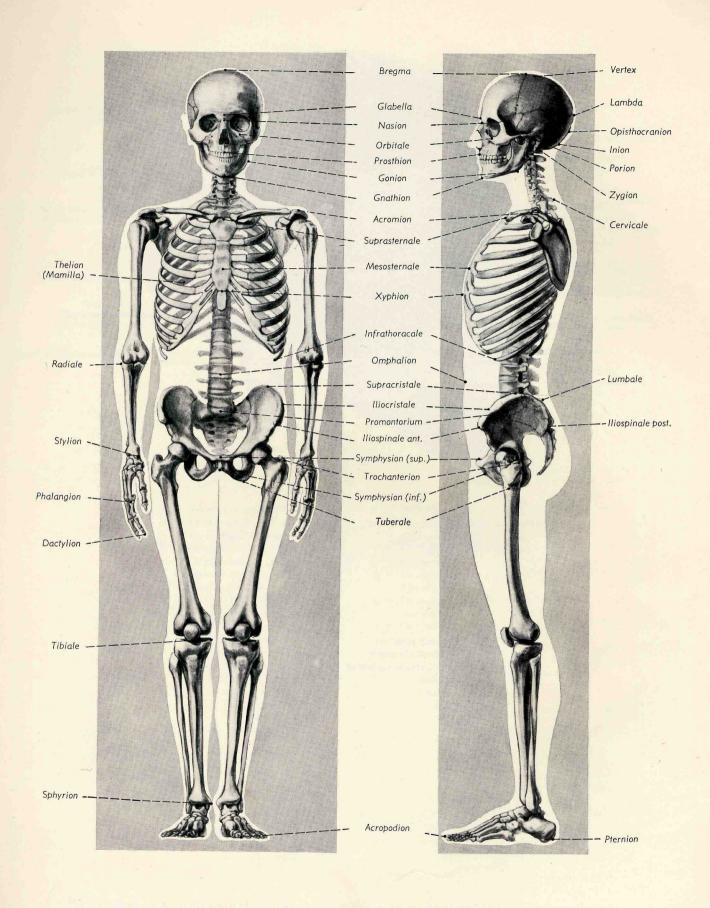


Fig. 1. Skeleton of the human body viewed from the front and from the left side. The more important points for skeletal measurements are indicated.

Acromion (tip of shoulder): Flat, lateral projection of the scapular spine overhanging the shoulder joint; origin of the trapezius and deltoid muscles.

Acropodion: The most distant soft part of the big toe. Bregma (named by Aristotle): Point of junction of the coronal and sagittal sutures; craniometric point.

Cervicale: Anthropol., somatometric point; spine of the seventh cervical vertebra.

Dactylion: The most distal point on the middle finger of a hanging limb. Corresponding points on the remaining fingers are designated dactylion I, II, IV or V.

Glabella (L., small bald spot): 1) Anat., slightly curved part of the frontal bone between the superciliary arches, deep to an area of hairless skin. 2) Anthropol., an elevation on the forehead above the root of the nose between the eyebrows; a point above the nasofrontal suture between the superciliary arches.

Gnathion: The most prominent point in the median plane on the lower margin of the mandible.

Gonion: 1) Anat., the angle of the mandible. 2) Anthropol., the lowest, most posterior and externally located point on the angle of the mandible; a craniometric point at the intersection of a line along the inferior border of the body of the mandible with that along the posterior border of the ramus.

Iliocrista: The farthest laterally projecting point on the iliac crest.

Iliospinale anterius: The most downward projecting point of the anterior superior iliac spine; an osteometric point.

Iliospinale posterius: The most backward projecting point of the posterior superior iliac spine; an osteometric point.

Infrathoracale: The most lateral point on the lower margin of the bony thorax (here, the tip of the eleventh rib). Inion: The point of the external occipital protuberance; a

cephalometric and craniometric point.

Lambda: Anthropol., a point at the intersection of the sagittal and lambdoid sutures.

Lumbale: The tip of the spinous process of L5; a somatometric point.

Mesosternale: Point of intersection of a line connecting the fourth sternocostal joints with the median plane; a somatometric point.

Nasion (nasale): Point of intersection of the nasofrontal suture with the median plane; a craniometric point.

Omphalion (navel point): Central point of the umbilicus in the median plane; a somatometric point.

Opisthocranion: Most prominent point on the posterior aspect of the skull in the median plane used for measuring the greatest longitudinal diameter of the cranium.

Orbitale: Lowermost point on the inferior margin of the orbit.

Phalangion: Somatometric point on the dorsal aspect of the proximal surface of the metacarpophalangeal joint.

Porion: Craniometric point in the center of the upper margin of porus acusticus ext. "Skin-porion" at the corresponding site in the living.

Promontorium: More or less prominent anterior projection of the upper edge of the first sacral vertebra, forming an angle with L5 (up to 90 degrees).

Prosthion (upper alveolar point): Point of the most downward projecting alveolar process in the midline between the upper medial incisors.

Pternion: The farthest dorsally projecting (somatometric) point on the calcaneus of a weight-bearing foot.

Radiale: The highest (somatometric) point on the upper edge of the head of the radius (with the arm hanging by the side and the palm facing medially).

Sphyrion: Tip of the medial malleolus when standing.

Stylion: Tip of the styloid process of the radius with the arm hanging.

Supracristale: Highest point on the iliac crest in the lateral line.

Suprasternale (upper sternal point): Somatometric point in the jugular notch of sternum, in the median plane.

Symphysion (superior, interior): Somatometric point in the midline on the upper and lower borders of the symphysis, respectively.

Thelion (mamelon, mamillary point): Midpoint of the nipple; somatometric point (except in women with pendulous breasts).

Tibiale: Highest point on the proximal joint surface of the tibia in erect posture.

Trochanterion: Highest and most lateral point on the greater trochanter.

Tuberale: Lowest point on the downward projecting ischial tuberosity.

Vertex (crown): In erect posture, the highest point on the skull in the midline.

Xyphion: Suture between the body of sternum and the ziphoid process in the midline.

Zygion: The most lateral point on the zygomatic bone (zygomatic arch).

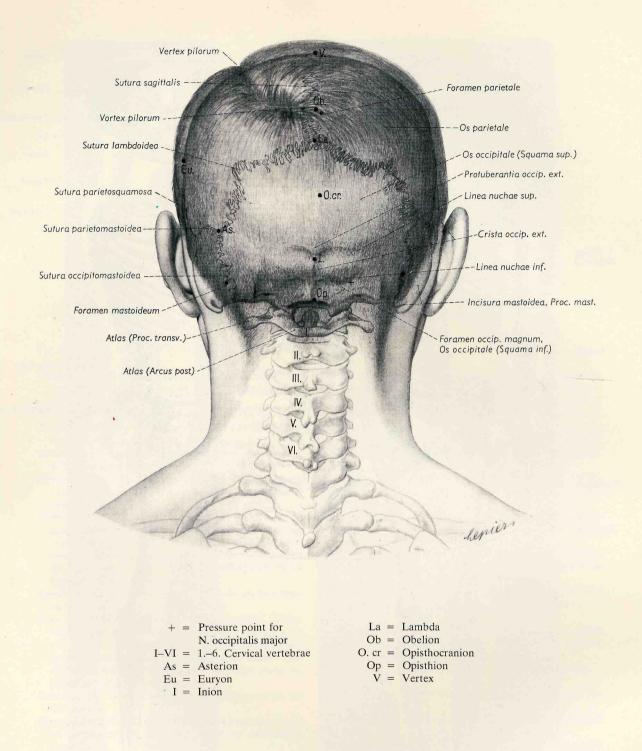
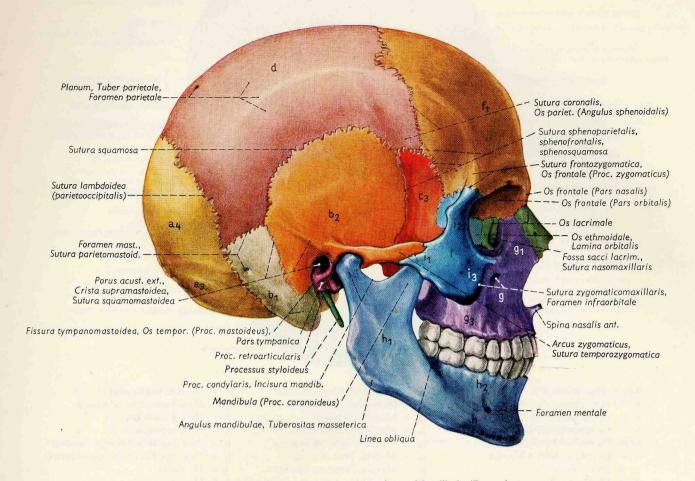


Fig. 2. External aspect of the male head viewed from behind, superimposed on the skeletal parts.



a₃, a₄ = Squama occipitalis
 b₁ = Os temporale, Pars mastoidea
 b₂ = Os temporale, Pars squamosa
 c₃ = Os sphenoidale, Ala major

d = Os parietale f₁ = Squama frontalis

g = Maxilla (Corpus)

 $g_1 = Maxilla$, Processus frontalis

g₃ = Maxilla, Processus alveolaris

h = Mandibula (Corpus)

 $h_1 = Mandibula (Ramus)$

h₂ = Mandibula, Processus alveolaris

i = Os zygomaticum

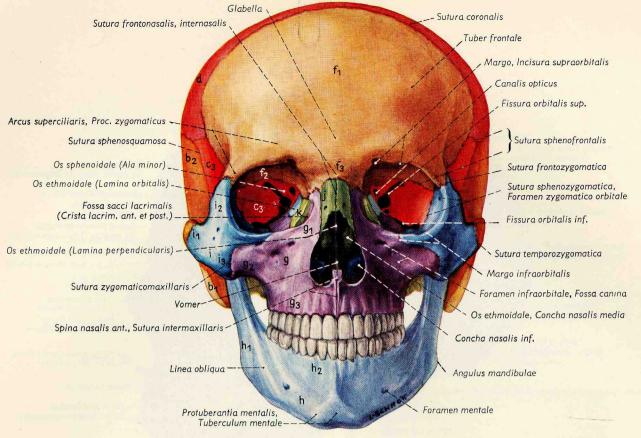
i₁ = Os zygomaticum, Processus temporalis

e Os zygomaticum, Processus frontalis

i₃ = Os zygomaticum, Processus

maxillaris j = Os nasale

Fig. 3. Right side of an adult skull. The bones of the neurocranium and the visceral cranium are shown in different colors; visceral cranium: blue, violet and green.



Key to Figs. 4 and 5

a₃ = Lower part of squama occipitalis
a₄ = Upper part of squama occipitalis
b₁ = Os temporale, Pars petrosa
b₂ = Os temporale, Squama
c₃ = Os sphenoidale, Ala major
d = Os parietale
f₁ = Os frontale, Squama

f₂ = Os frontale, Pars orbitalis
f₃ = Os frontale, Pars nasalis
g = Maxilla (Corpus)
g₁ = Maxilla, Proc. frontalis
g₂ = Maxilla, Proc. zygomaticus
g₃ = Maxilla, Proc. alveolaris
g₄ = Maxilla, Processus palatinus
h = Mandibula (Corpus)

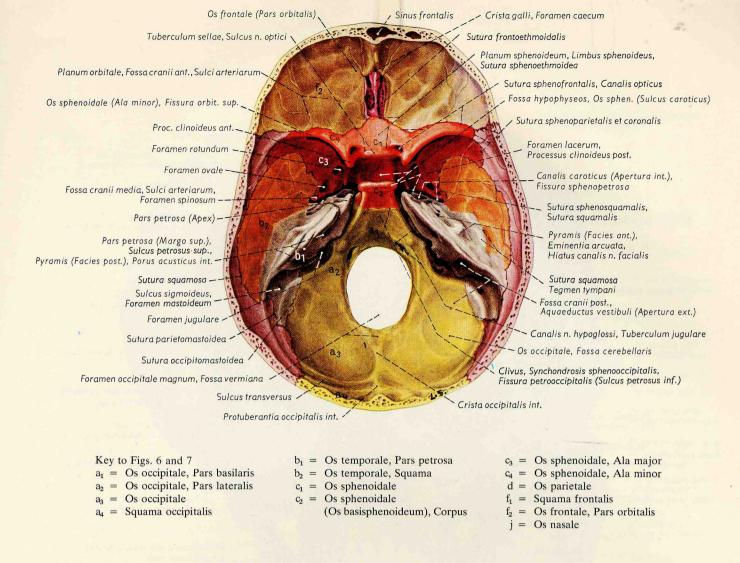
 $\begin{array}{lll} h_1 &=& Mandibula \ (Ramus) \\ h_2 &=& Mandibula, Proc. \ alveolaris \\ i &=& Os \ zygomaticum \\ i_1 &=& Proc. \ temporalis \\ i_2 &=& Proc. \ frontalis, Os \ zygomaticum \\ i_3 &=& Proc. \ maxillaris, Os \ zygomaticum \\ j &=& Os \ nasale \end{array}$

k = Os lacrimale

Sutura sagittalis, Foramen parietale Sutura lambdoidea, Os parietale (Angulus occip.) Tuber parietale Sutura parietomastoidea -Squama occipitalis Linea nuchae suprema Protuberantia et crista occip. ext., Os temporale (Squama) -Linea nuchae superior inea nuchae inf., Planum nuchale Sutura occipitomastoidea, Foramen mast. Proc. mastoideus Incisura mastoidea Processus styloideus Condylus occipitalis Processus pterygoideus (Lamina lateralis, rot) Tuber retromolare Foramen mandibulae, Lingula Maxilla (Processus alveolaris) Concha nasalis inferior Processus pterygoideus (Lamina medialis) Os palatinum (Lamina horizontalis), Angulus mandib., Tuberositas pterygoidea Processus pyramidalis Fovea sublingualis, Sulcus mylohyoideus Fossa digastrica, Spina mentalis Sutura palatina mediana, For. incisivum'

Fig. 4. (Top) Adult skull from the front (neurocranium: yellow, orange and red; visceral cranium: blue, violet and green).

Fig. 5. (Bottom) Adult skull seen from behind.



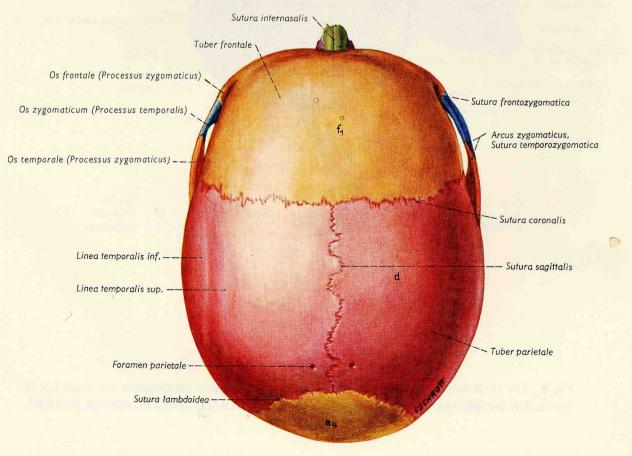


Fig. 6. (Top) Base of skull seen from the inside.

Fig. 7. (Bottom) Adult human skull seen from above (calvaria, skullcap).

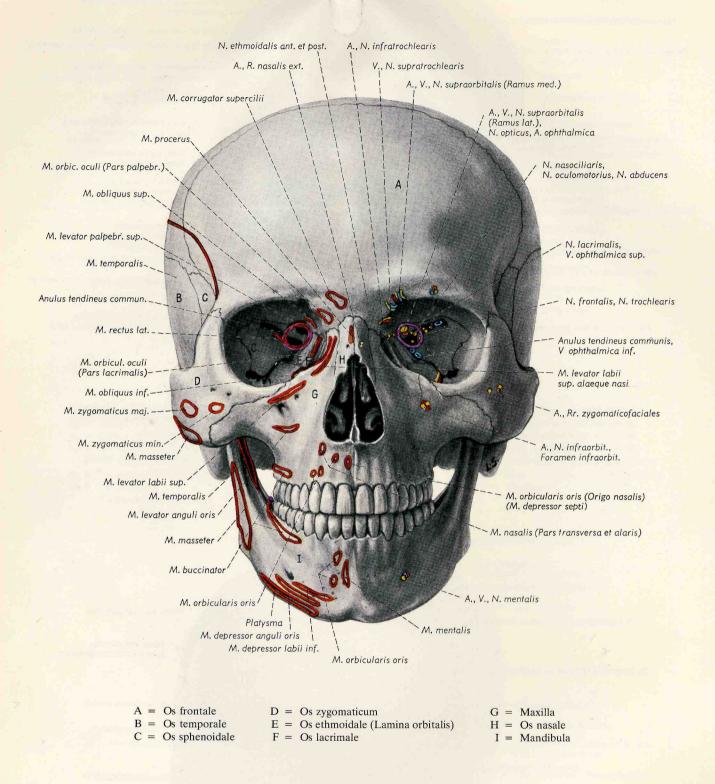


Fig. 8. The skull from the front. On the right, areas of muscle attachments are encircled in brown. On the left, blood vessels and nerves are indicated where they pass through foramina.

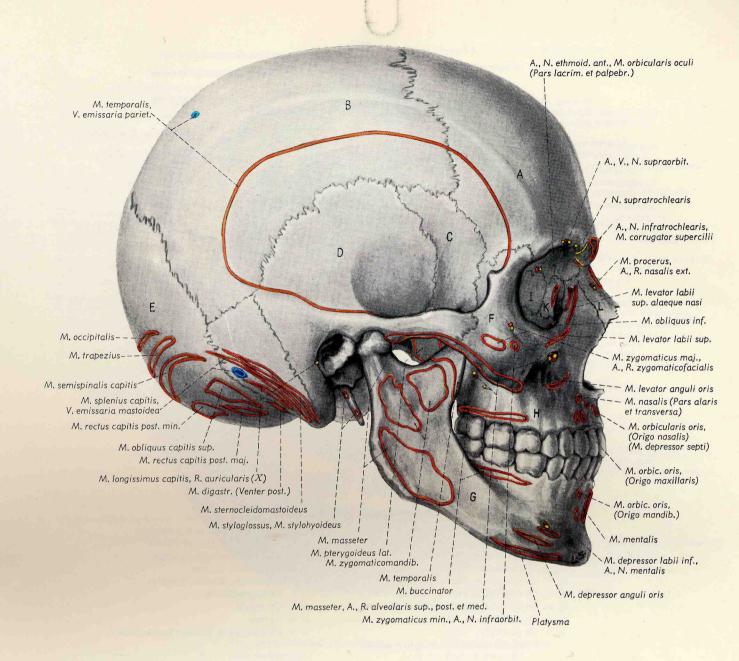


Fig. 9. Lateral view of skull. Areas of muscle attachments are encircled in brown.

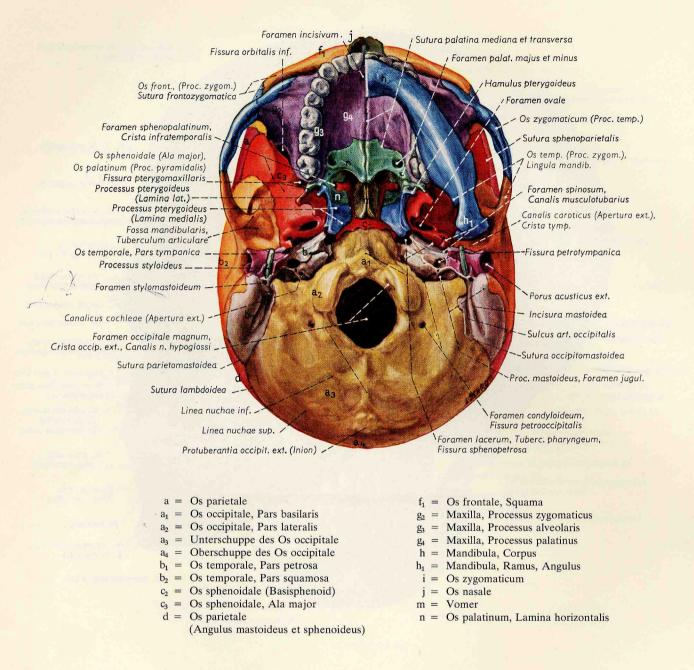


Fig. 10. The bony base of the skull from below. The right half of the mandible has been removed.

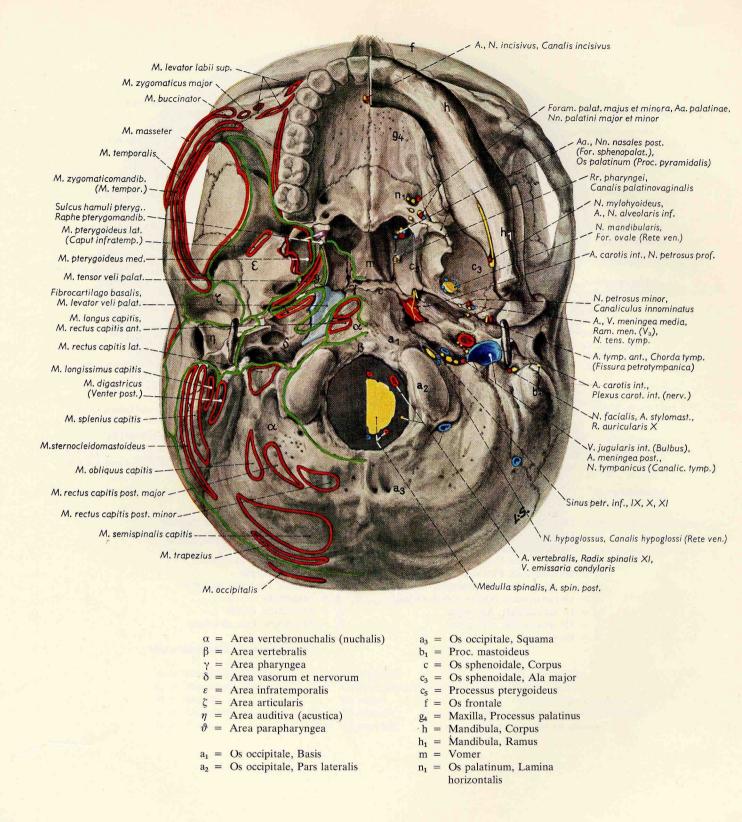
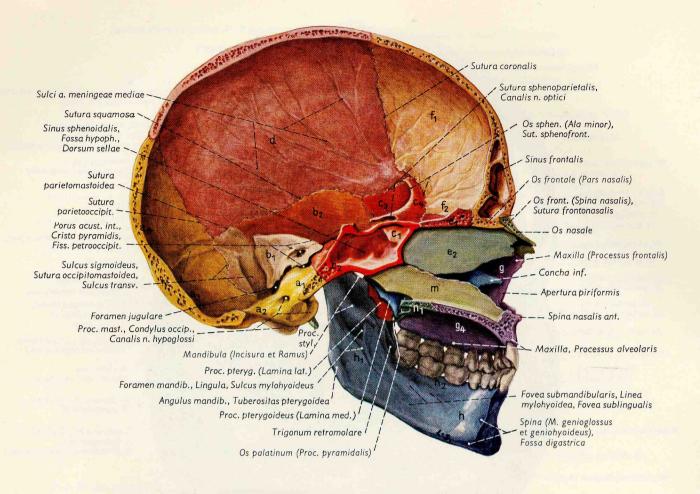


Fig. 11. The base of the cranium and its areas of muscle attachments seen from below. The right half of the mandible has been removed. On the right side, the areas of muscle origins are encircled in brown; other basal cranial areas (see key) are outlined in green. On the left, vessels and nerves are indicated where they pass through foramina.



 a_1 = Os occipitale, Pars basilaris

a₂ = Os occipitale, Pars lateralis

= Squama occipitalis

 $b_1 = Os temporale, Pars petrosa$ b₂ = Os temporale, Pars squamosa

c₁ = Os sphenoidale (Os praesphenoideum)

= Os sphenoidale (Os basisphenoideum)

 c_3 = Os sphenoidale, Ala major

 c_4 = Os sphenoidale, Ala minor

d = Os parietale

e₁ = Os ethmoidale, Lamina cribrosa

e₂ = Os ethmoidale, Lamina perpendicularis

 f_1 = Os frontale, Squama

f₂ = Os frontale, Pars orbitalis

g = Maxilla, Corpus

g₄ = Maxilla, Processus palatinus

h = Mandibula, Corpus

h₁ = Mandibula, Ramus

h₂ = Mandibula, Pars alveolaris

m = Vomer

 n_1 = Os palatinum, Lamina horizontalis

Fig. 12. Adult skull, midsagittal section (left half).

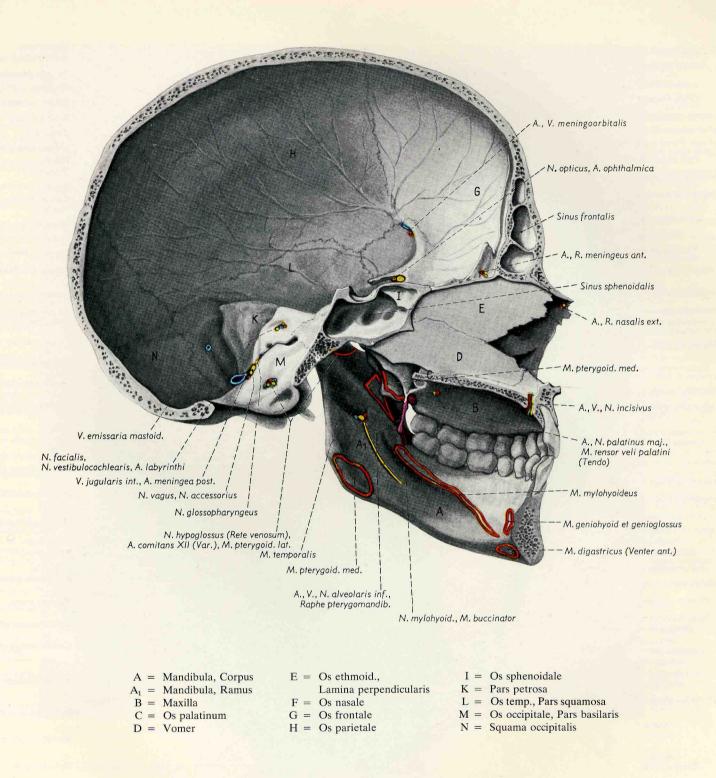


Fig. 13. Skull in median section (left half). Areas of muscle attachments are encircled in brown; vessels and nerves are indicated where they pass through foramina.

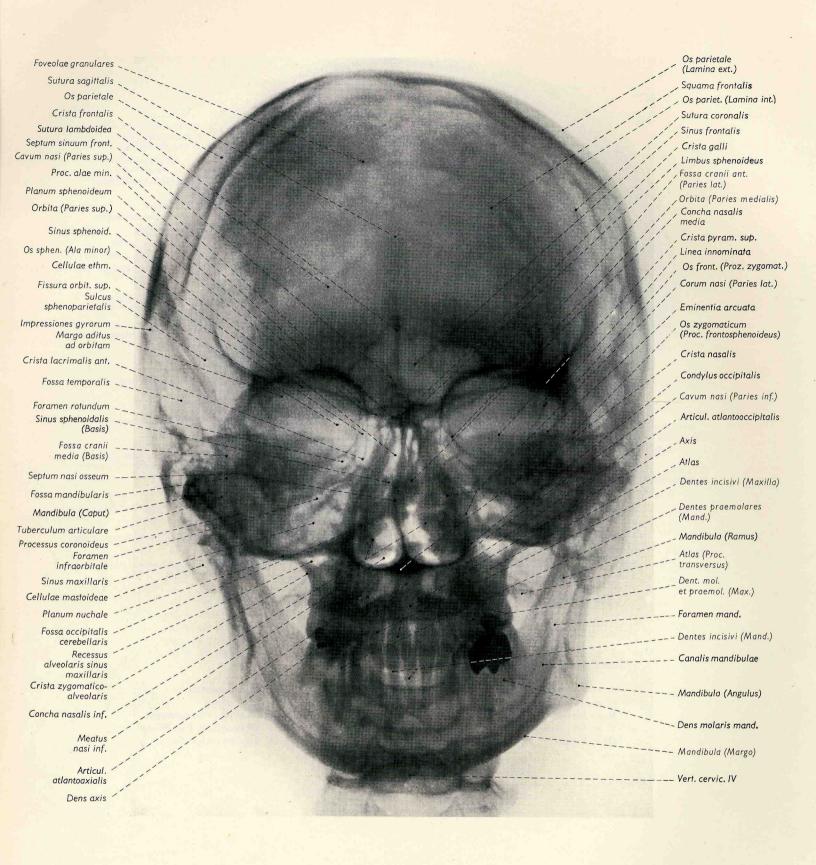


Fig. 14. Posteroanterior roentgenogram of skull (from Clementschitsch).

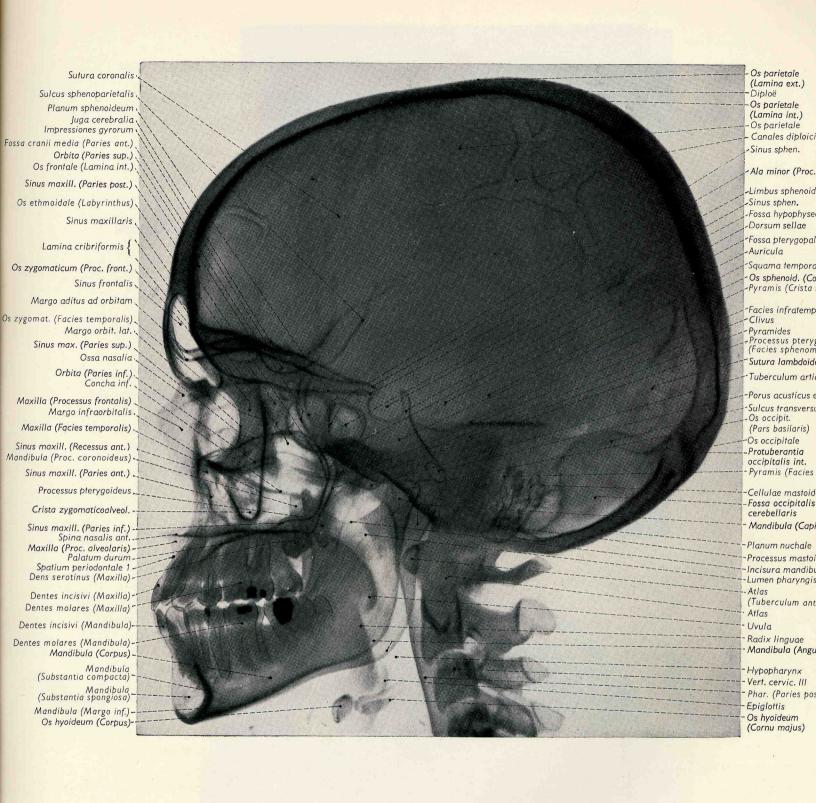


Fig. 15. Lateral roentgenogram of adult human skull (from Clementschitsch).

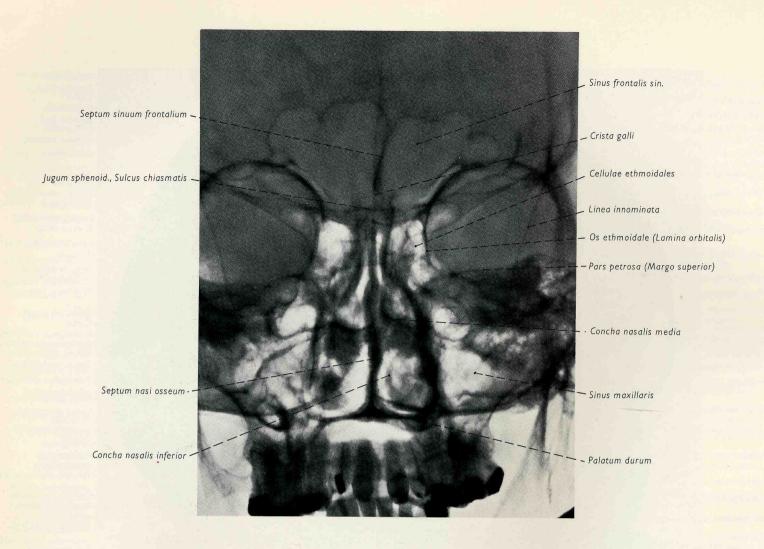


Fig. 16. Posteroanterior roentgenogram of paranasal sinuses I (L. Wicke, Vienna).

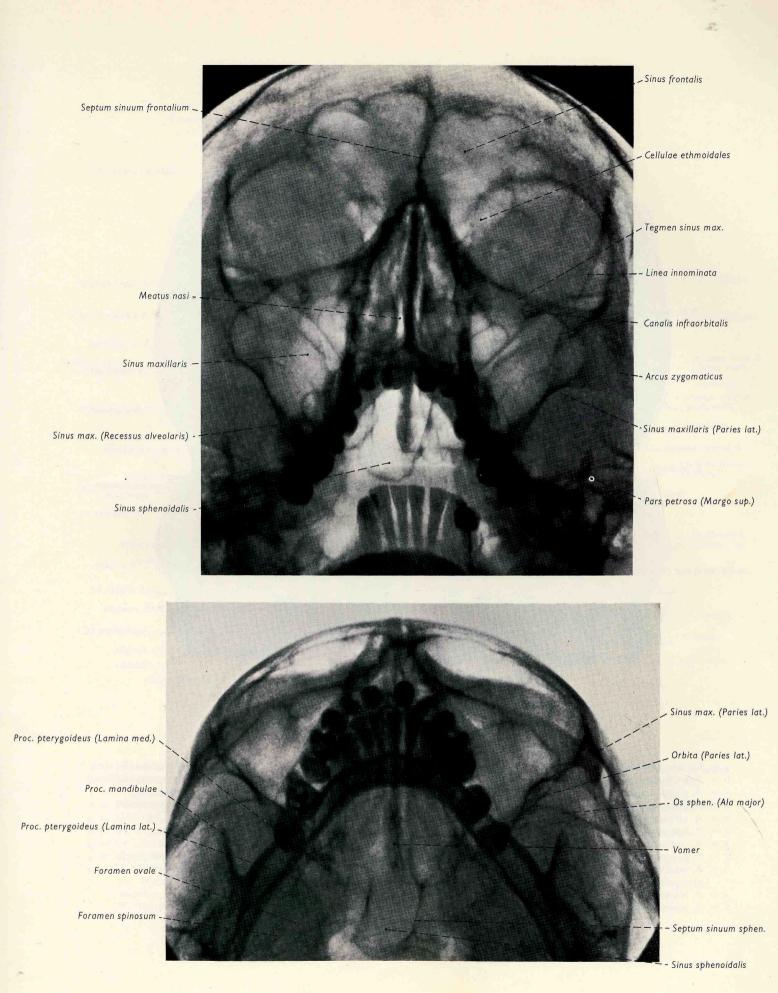


Fig. 17. (Top) Paranasal sinuses II; head is tilted back with mouth open (L. Wicke, Vienna).

Fig. 18. (Bottom) Paranasal sinuses III, axial view (L. Wicke, Vienna).

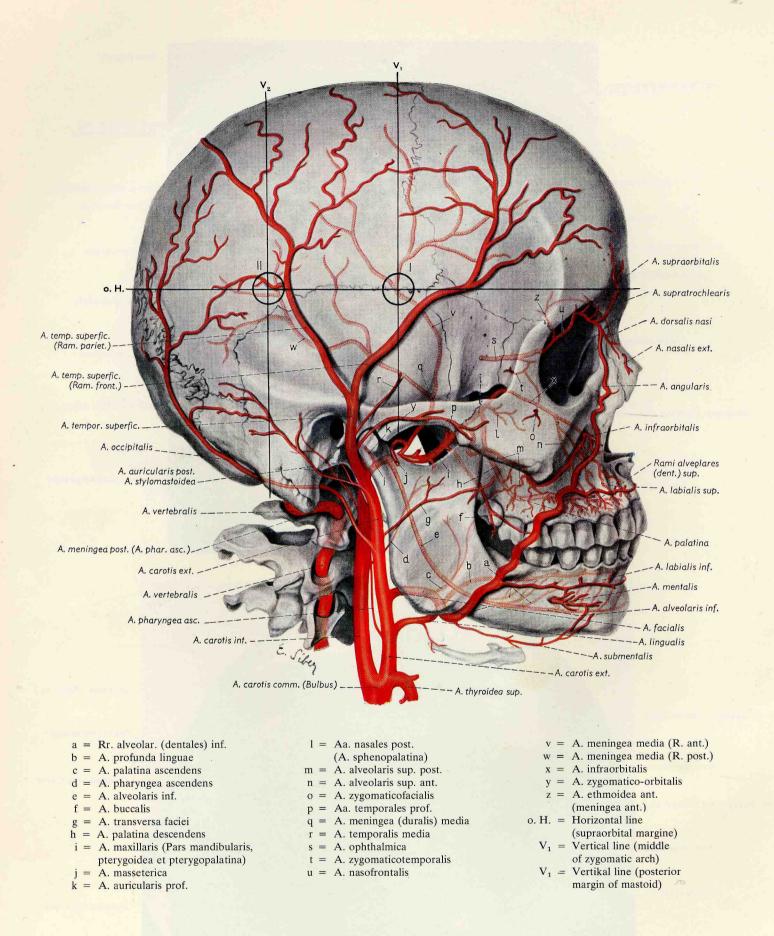


Fig. 19. Semischematic representation of the large arteries of the head. Krönlein's points I and II are anterior and posterior trepanation sites for ligation of the middle meningeal artery.

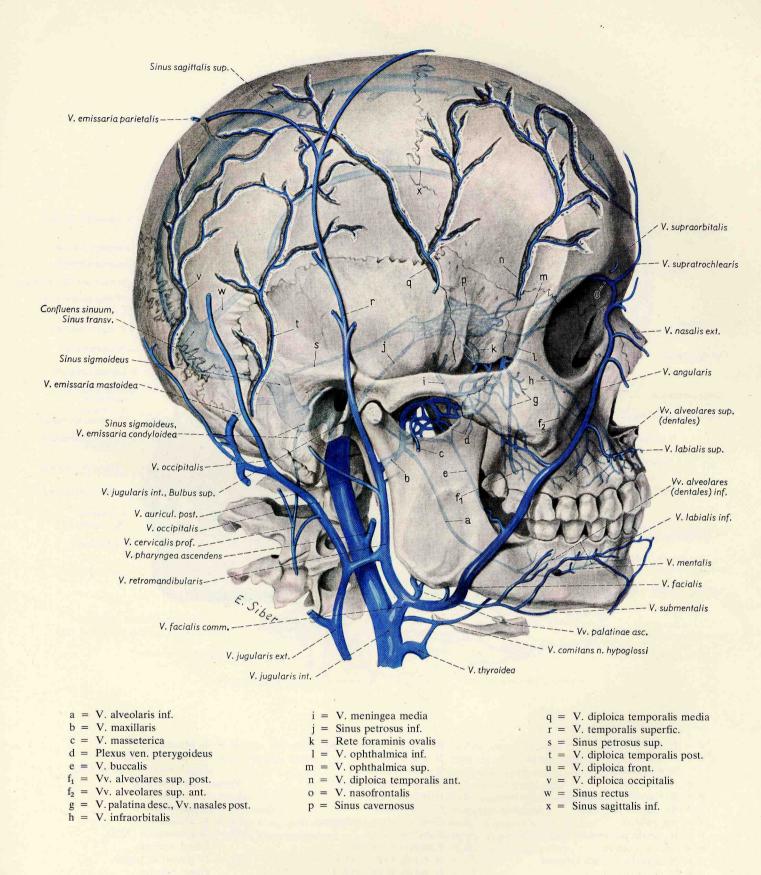


Fig. 20. The large veins of the head and their branches (semischematic). Deep veins and dural sinuses normally obscured by bone are projected on the bony skull.

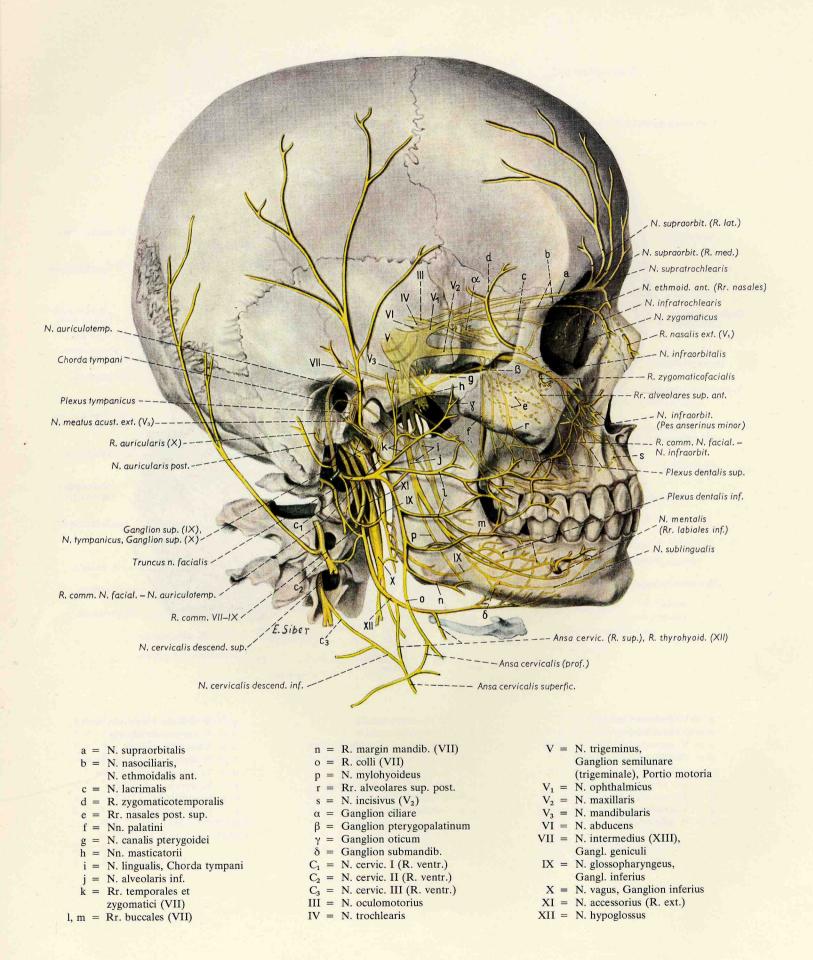
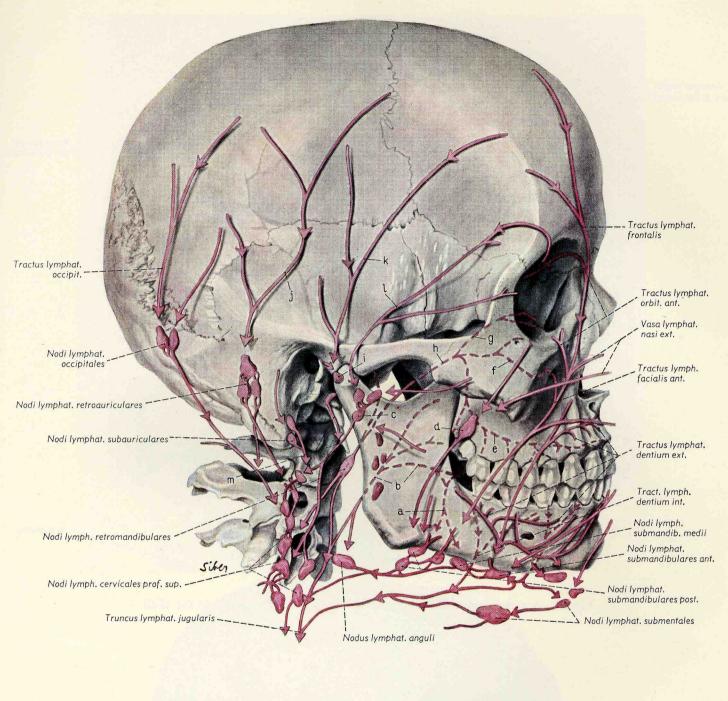


Fig. 21. The nerves of the head (semischematic).



- a = Inferior, anterior efferent lymph vessels from palatine tonsil
- b = Posterior, superior drainage (of tonsils)
- c = Parotid lymph nodes
- d = Buccal lymph node
- e = Deep drainage from teeth of upper jaw
- f = Lymph vessels along infraorbital a.
- g = Posterior orbital drainage
- h = Lymph vessels along maxillary a.
- i = Preauricular lymph nodes
- j = Retroauricular lymph tract
- k = Middle temporal lymph channel along the superfic. temporal a.
- 1 = Anterior temporal lymph channel along the zygomaticoorbital a.
- m = Posterior facial lymph tract

Fig. 22. Lymph channels of the head and associated lymph nodes (schematic). Deep vessels are indicated by broken lines. Lymph vessels of the tongue, pharynx and so forth are not included.

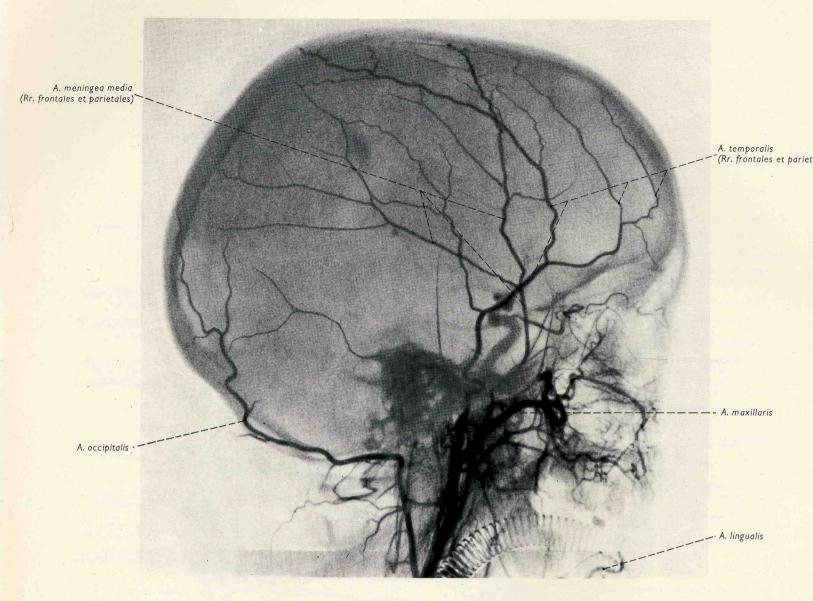
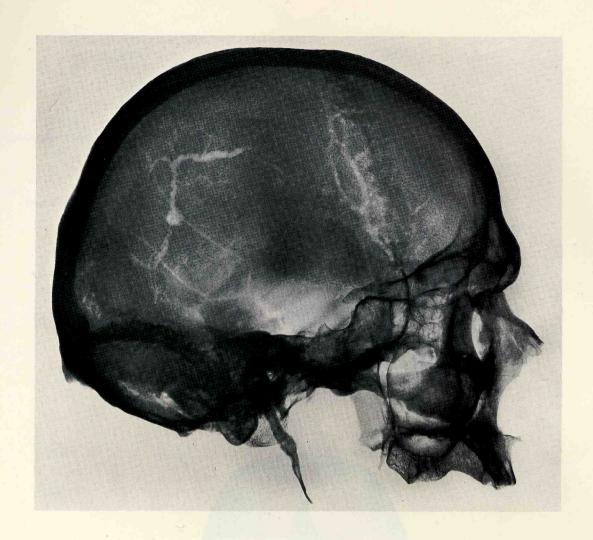
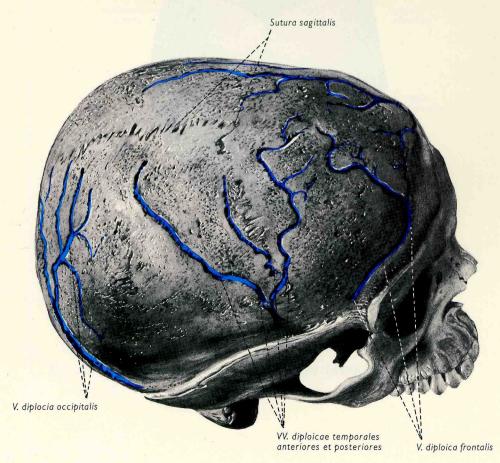


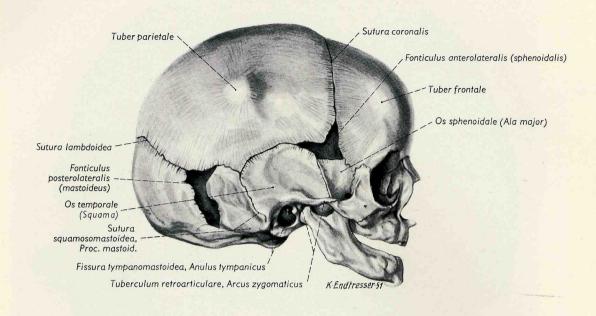
Fig. 23. Arteriogram of external carotid artery and its branches to the skull.

Fig. 24. (Right, top) Lateral roentgenogram of diploic veins.

Fig. 25. (Right, bottom) Diploic veins of the skullcap prepared by removing the outer table of the calvaria (from Sobotta/Becher).







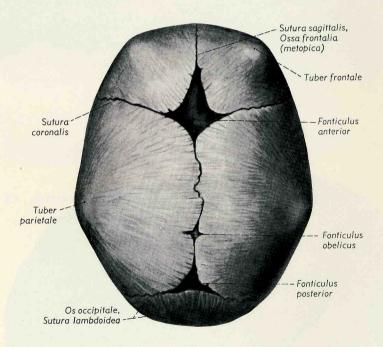


Fig. 26. (Top) Skull of a newborn seen from the right.

Fig. 27. (Bottom) Skull of a newborn seen from above.

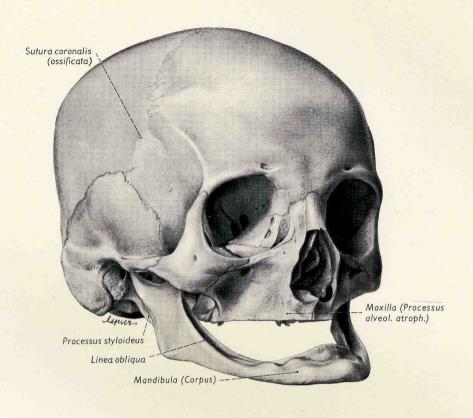


Fig. 28. Skull of an aged edentulous individual (one half normal size).

Brain and Meninges

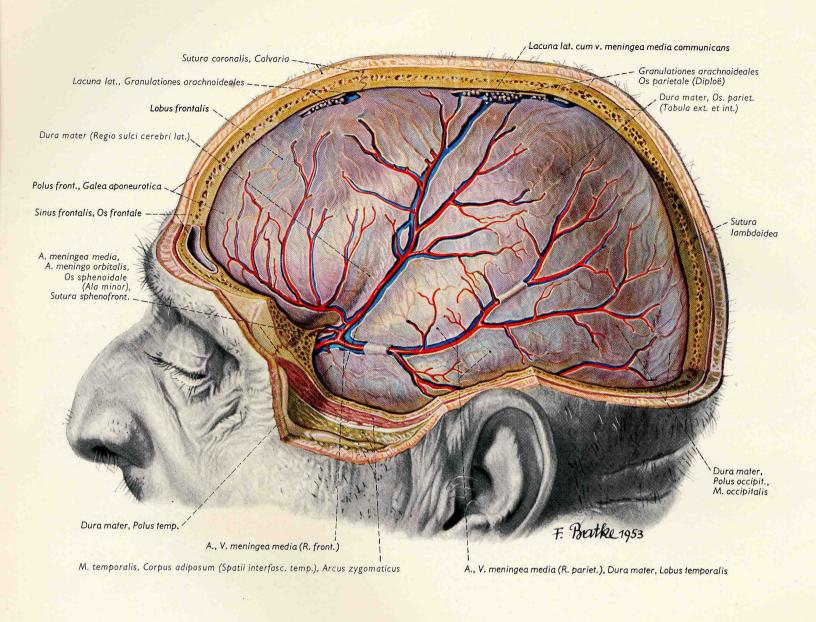


Fig. 29. Lateral exposure of the dural covering of the brain with the middle meningeal artery and veins.

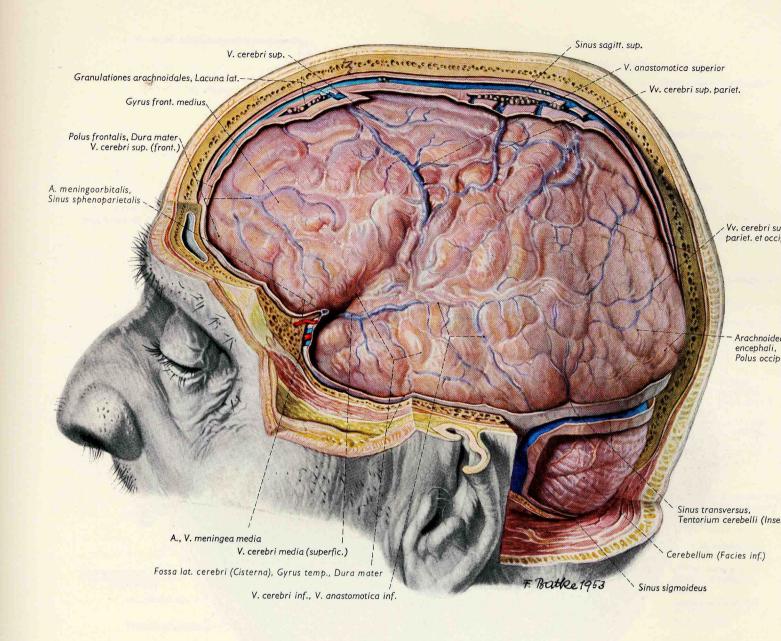


Fig. 30. Left cerebral hemisphere and cerebellum, in situ, covered by the arachnoid layer.

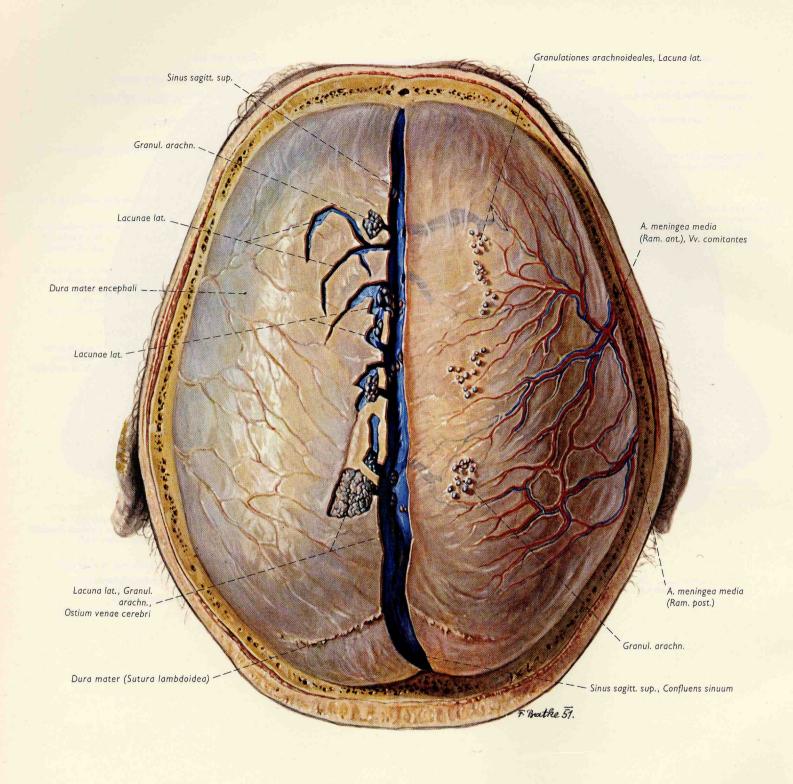


Fig. 31. Surface of dura mater from above after removal of the skullcap by means of a circular saw cut. Superior sagittal sinus and lateral lacunae are opened.

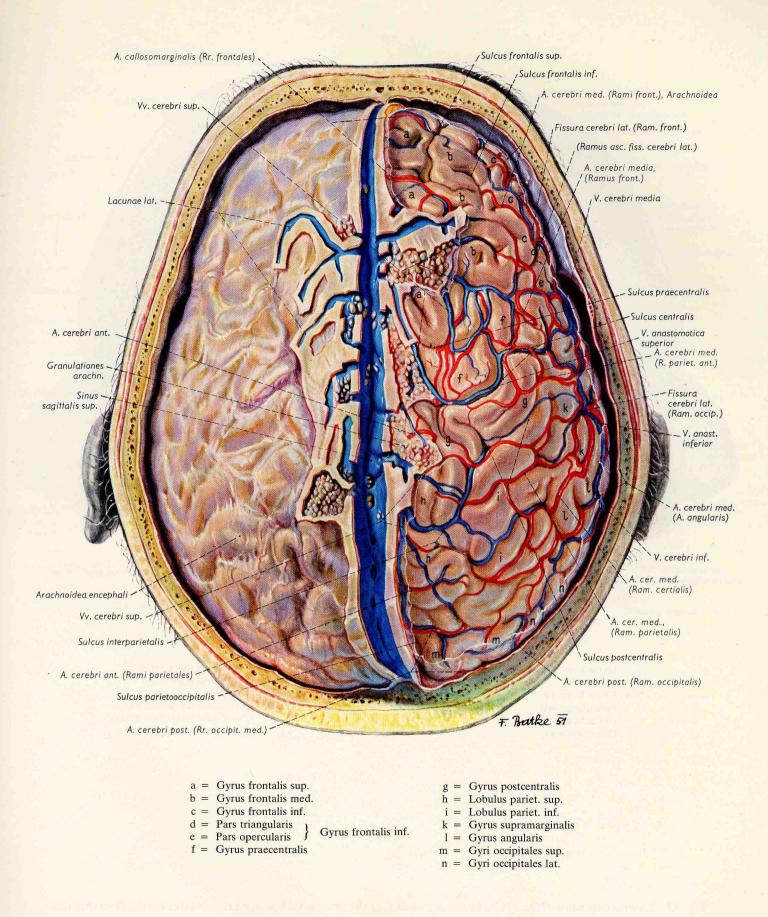


Fig. 32. Exposure of the brain from above. The arachnoid has been removed from the right hemisphere to demonstrate blood vessels; the arachnoid is intact on the left side.

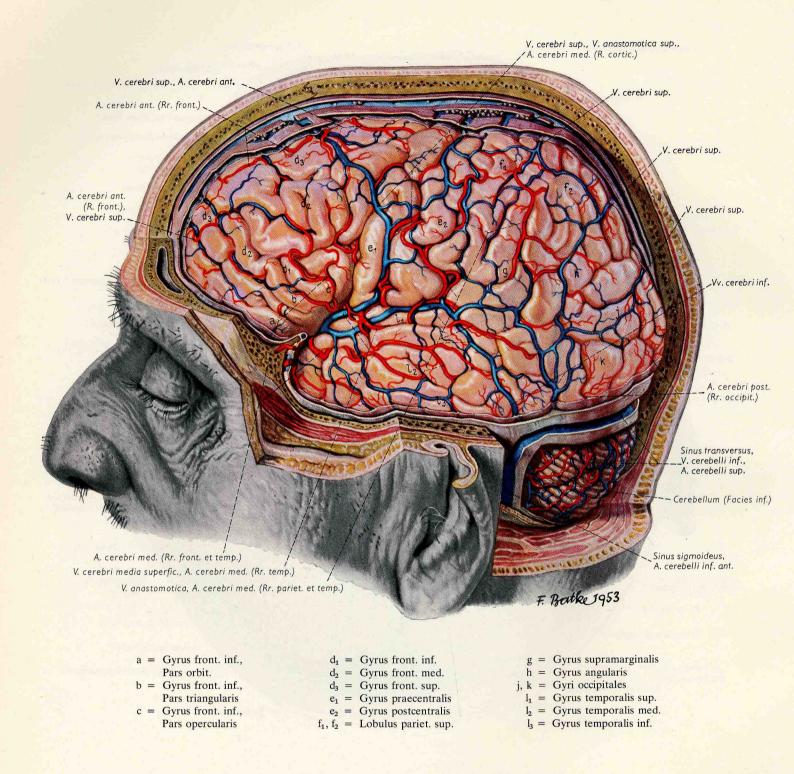


Fig. 33. Lateral exposure of the brain. In the exposed area the arachnoid has been removed completely so that the left hemispheres of the cerebrum and cerebellum and their blood vessels may be seen.

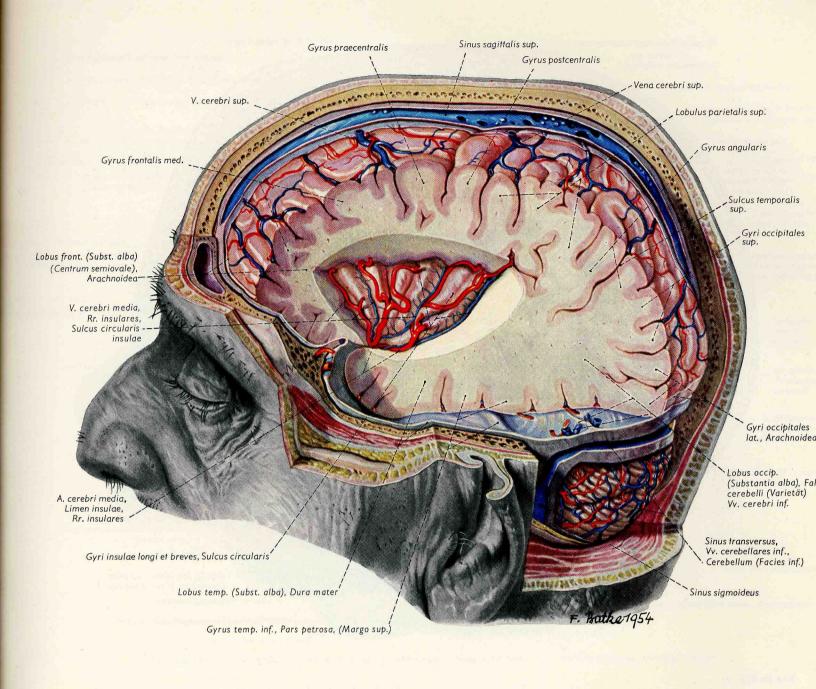
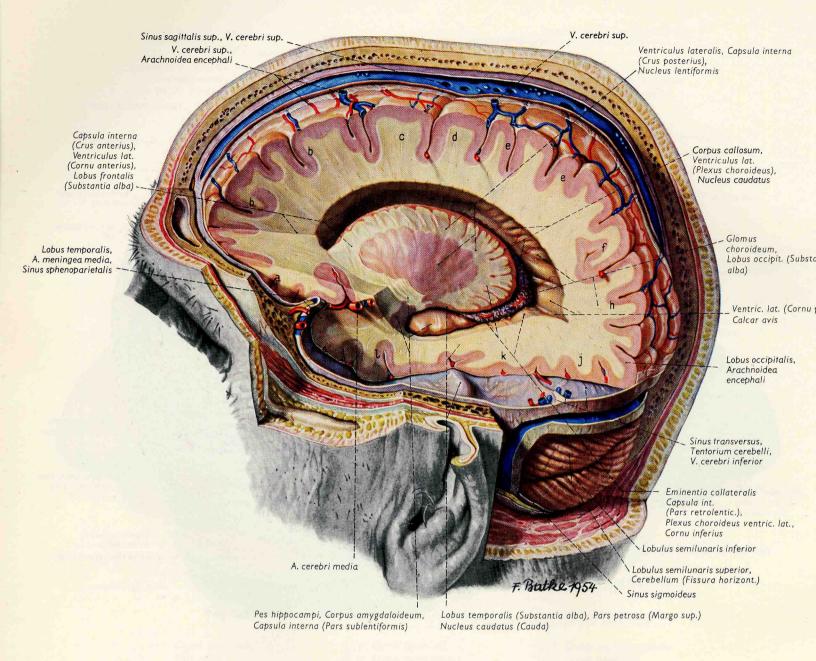


Fig. 34. Exposure of the insula by parasagittal section and removal of the opercula.



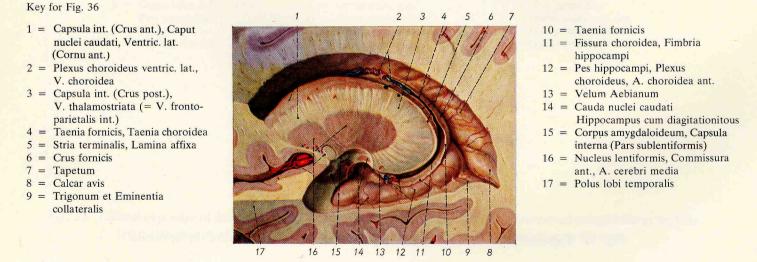
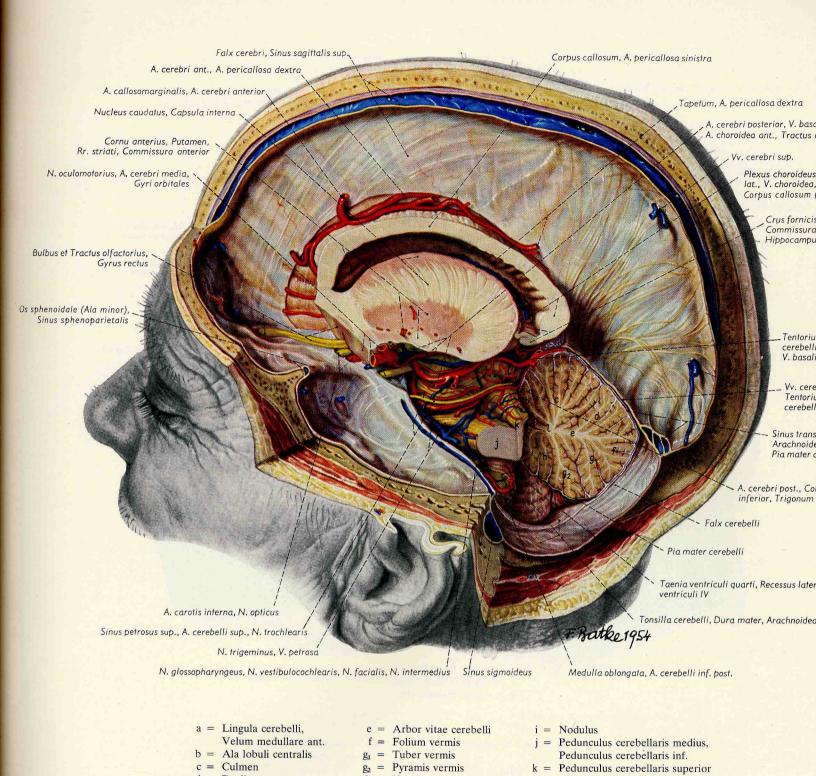


Fig. 35. (Top) Lateral exposure of the brain. The lateral ventricle has been opened.

Fig. 36. (Bottom) Left lateral ventricle, basal ganglia and internal capsule.

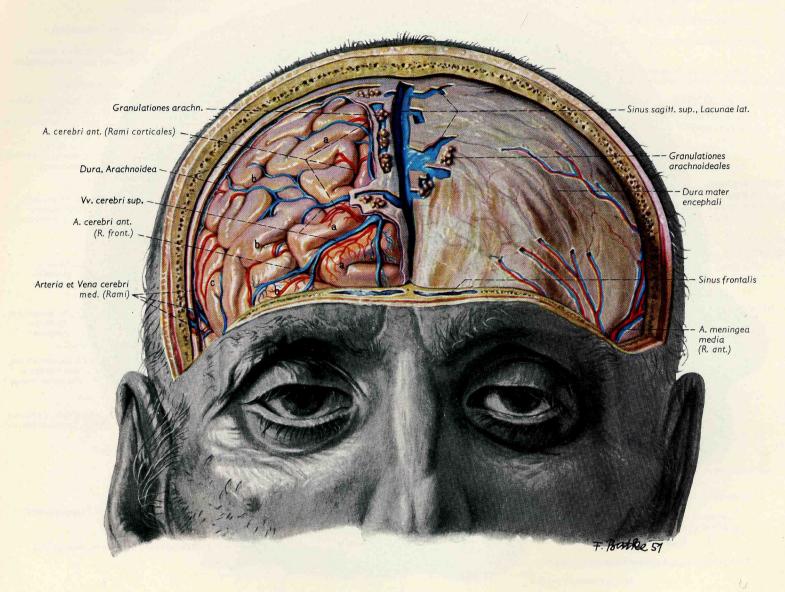


l = Fastigium

h = Uvula

d = Declive

Fig. 37. Lateral exposure of the brain. The left hemisphere is almost completely removed.



a = Gyrus frontalis sup.b = Gyrus frontalis med.

c = Gyrus frontalis inf.

Fig. 38. View of telencephalon from the front. Skullcap has been removed back to the coronal suture.

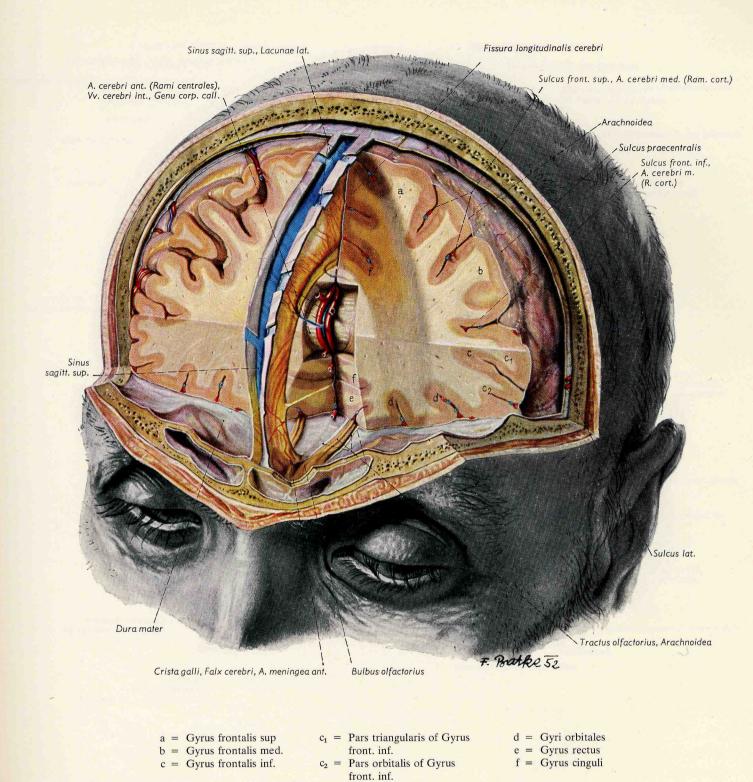


Fig. 39. View of the olfactory bulb and tract and the genu of corpus callosum. Parts of both frontal lobes have been removed, leaving falx cerebri intact.

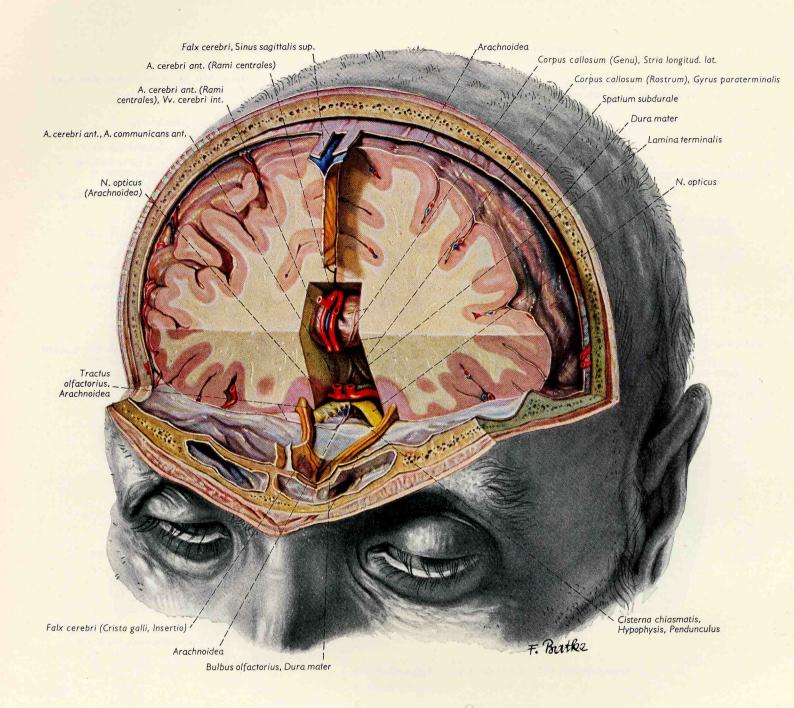


Fig. 40. View of brain from the front. By further removal of portions of the frontal lobes and falx cerebri, the region of sella turcica with vessels and nerves is exposed. Note the relationship of the anterior cerebral arteries to the optic nerve.

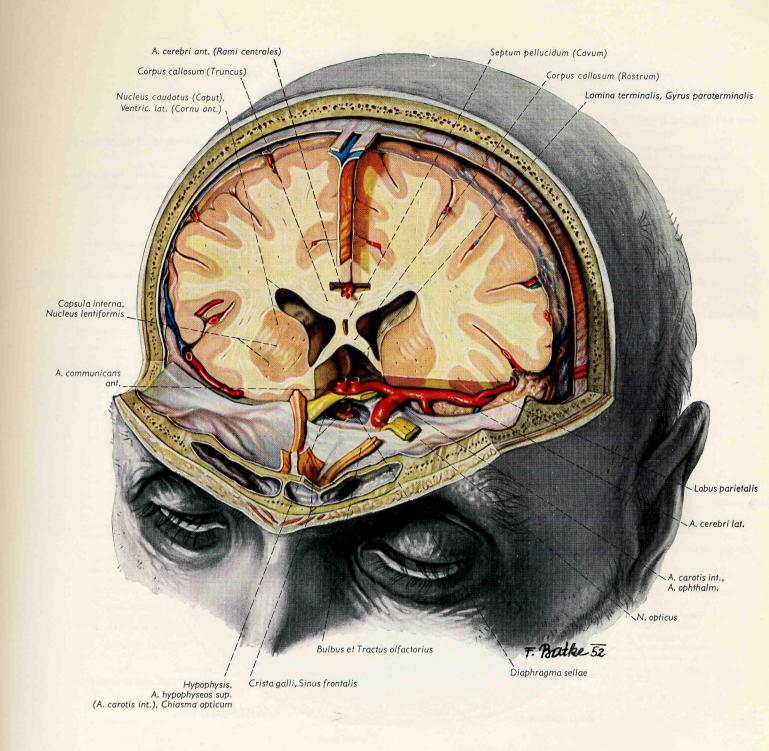


Fig. 41. Arteries and nerves of the suprasellar hypophyseal region; branching internal carotid artery. The upper surface of the hypophysis and the infundibulum are visible. Frontal section of the hemispheres at the level of the optic chiasm.

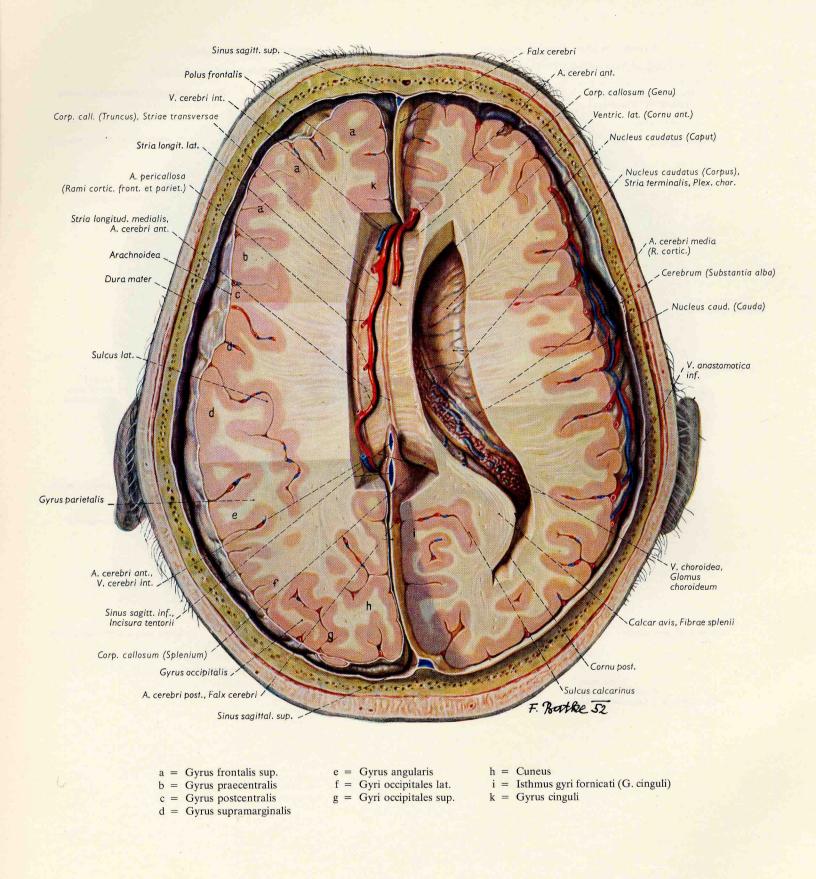


Fig. 42. The top part of telencephalon has been removed by a horizontal section above corpus callosum. The right lateral ventricle (anterior horn, central part, posterior horn) is opened.

Fig. 43. View of brain from above. Demonstration of tela choroidea of the forebrain; the veins of the tela are shown on the right. The entire choroid plexus of the lateral ventricles has been preserved on both sides. The right half of the pineal gland is seen in its leptomeningeal bed. The right transverse sinus has been opened in the region of the tentorium.

Fig. 44. View of the brain from above. Corpus callosum has been removed by a series of frontal and sagittal sections so that the body of fornix and the hippocampal commissure are brought into view in the center; on the sides, the inferior horn and the choroid plexus of the lateral ventricle may be seen. Septum pellucidum has been cut horizontally so as to open cavum septi pellucidi.

Fig. 45. Horizontal section through brain and skull above the thalamus. Demonstration of the cavities of the lateral ventricles.

Fig. 46. The brain viewed from above. The tentorium has been removed bilaterally posterior to a frontal section through the occipital lobe, preserving the transverse sinus. On the left side, the arachnoid over cerebellum is intact; on the right, it has been removed so that blood vessels on the upper surface of cerebellum may be seen.

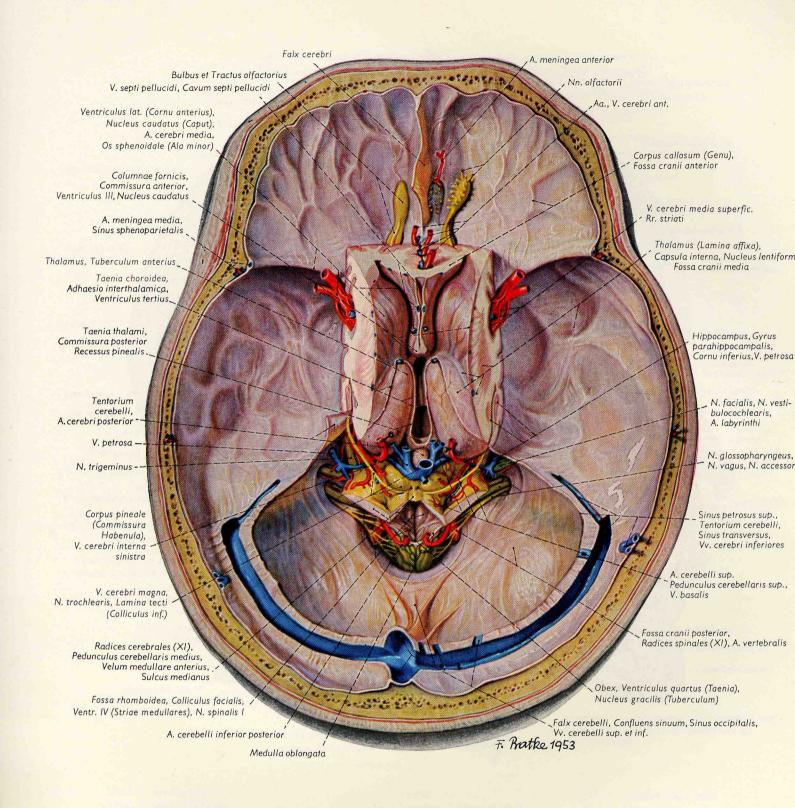


Fig. 47. The brain stem (truncus cerebri) in situ. Intracranial course of cranial nerves. Relationships of the brain stem to the cranial fossae.

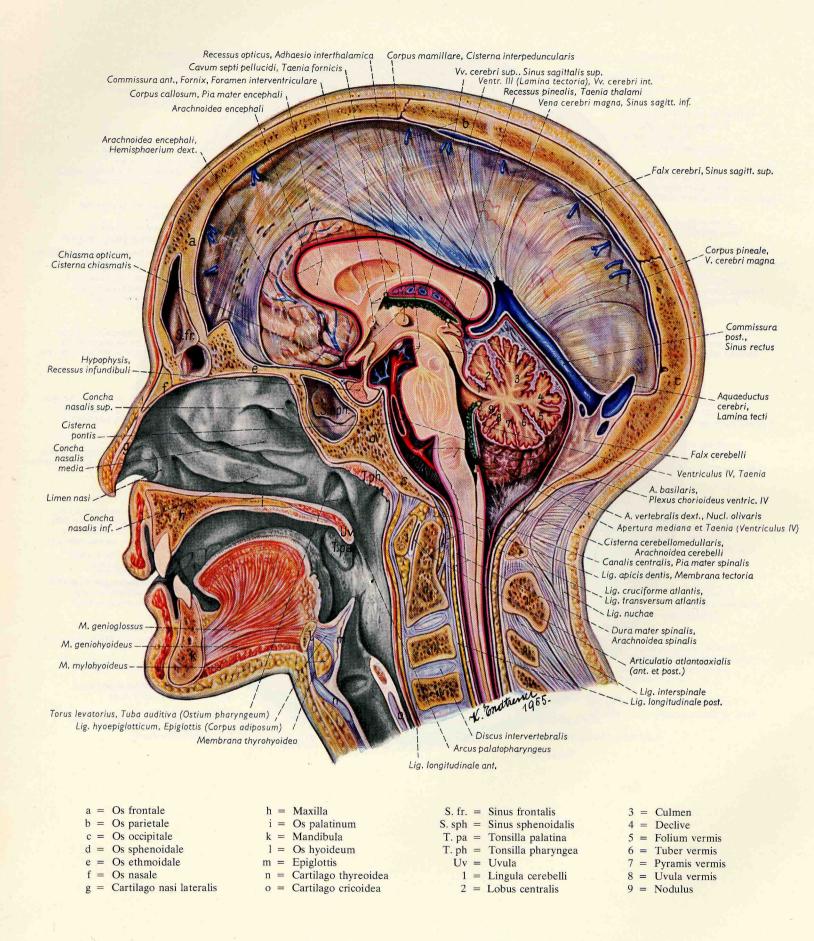
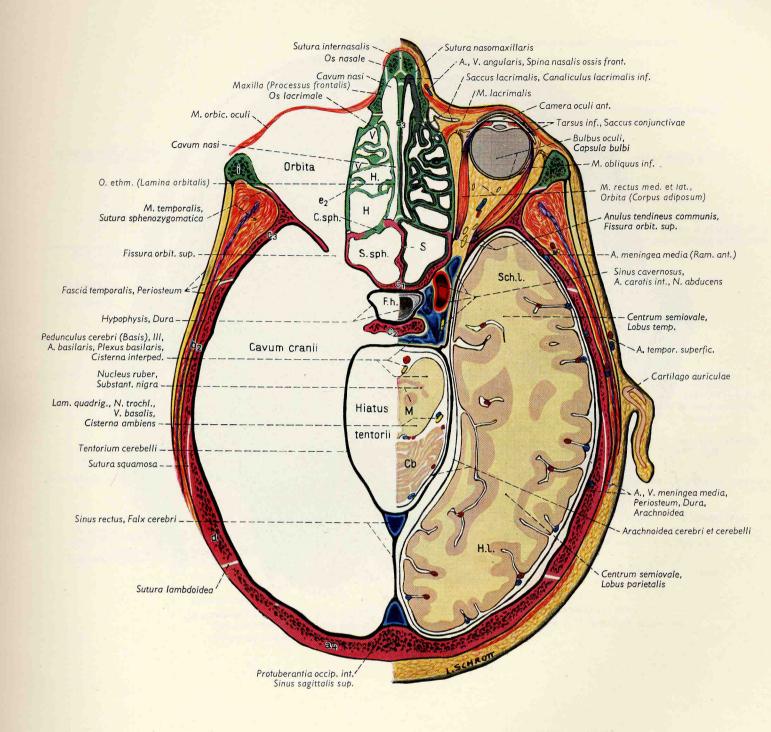


Fig. 48. Median section through the head. The cut edges of the leptomeninges are red. The cut surfaces of the tela choroidea, as well as the choroid plexus, are indicated in green.



Red = neurocranium d = Os parietale H. = Cellulae ethm. post. e₂ = Os ethmoidale, Lamina orbitalis H. 1 = Lobus occip. Green = visceral cranium e₃ = Os ethmoidale, Lamina mediana M. = Mesencephalon a₄ = Squama occipitalis S. = Septum sinus sphenoid. b_2 = Squama temporalis i = Os zygomaticum c_1 = Praesphenoid Cb = Cerebellum Sch. 1 = Lobus temp.C. sph = Concha sphenoidalis S. sph = Sinus sphenoidalis c_2 = Basisphenoid (Dorsum sellae) c_3 = Os sphenoidale, Ala major F. h = Fossa hypophyseosV = Cellulae ethm. ant.

Fig. 49. Horizontal section through the head at the level of the external occipital protuberance. On the left, the skeleton with muscles; on the right, mucosal membranes and the contents of cranial spaces.

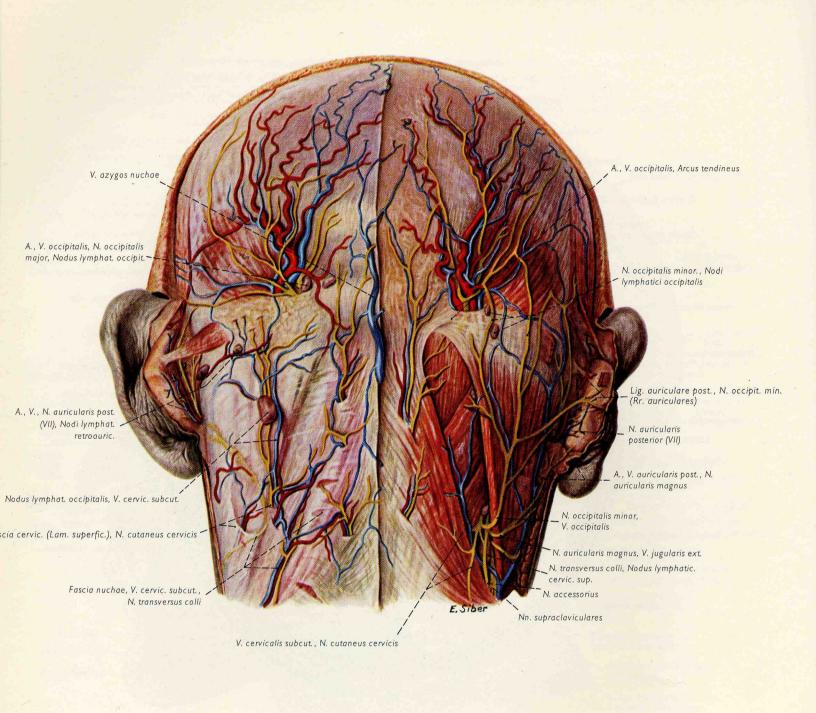


Fig. 50. Blood vessels and nerves of posterior head region and upper neck.

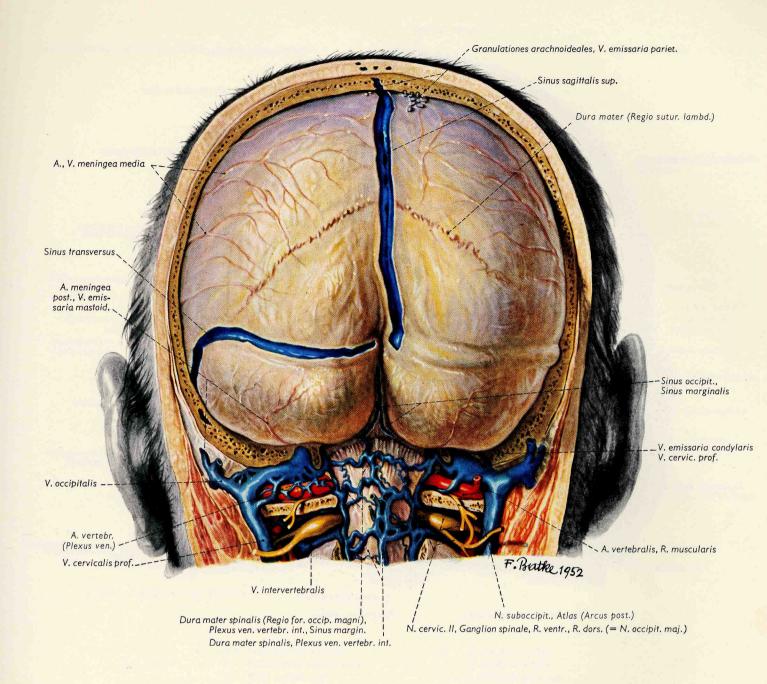


Fig. 51. Dura mater and the dural sinuses of the posterior head region.

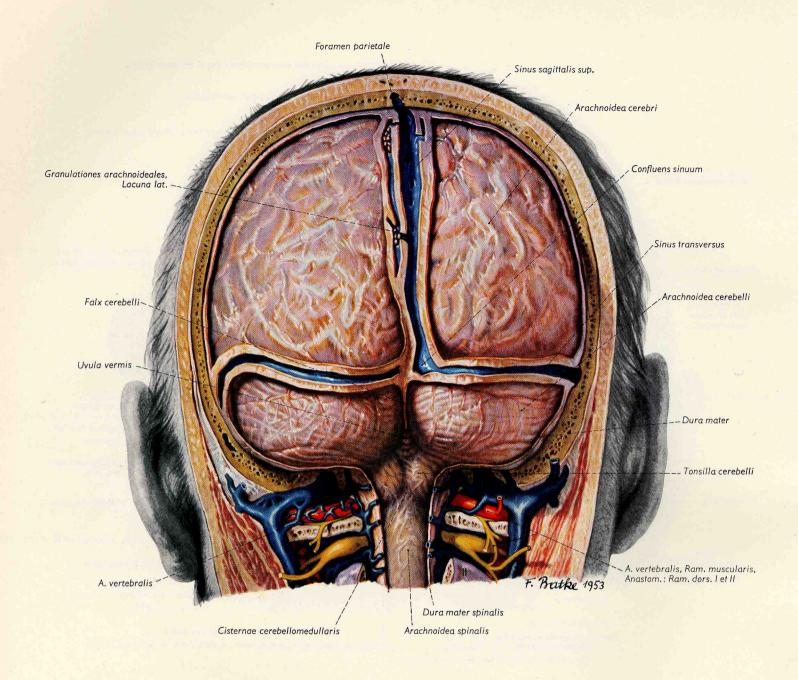


Fig. 52. Parietal and occipital lobes with cerebellum and medulla oblongata exposed from behind. The dura mater has been removed except for those portions immediately adjacent to the falx cerebri, the tentorium and the falx cerebelli. All portions of the brain are enclosed by the intact arachnoid layer.

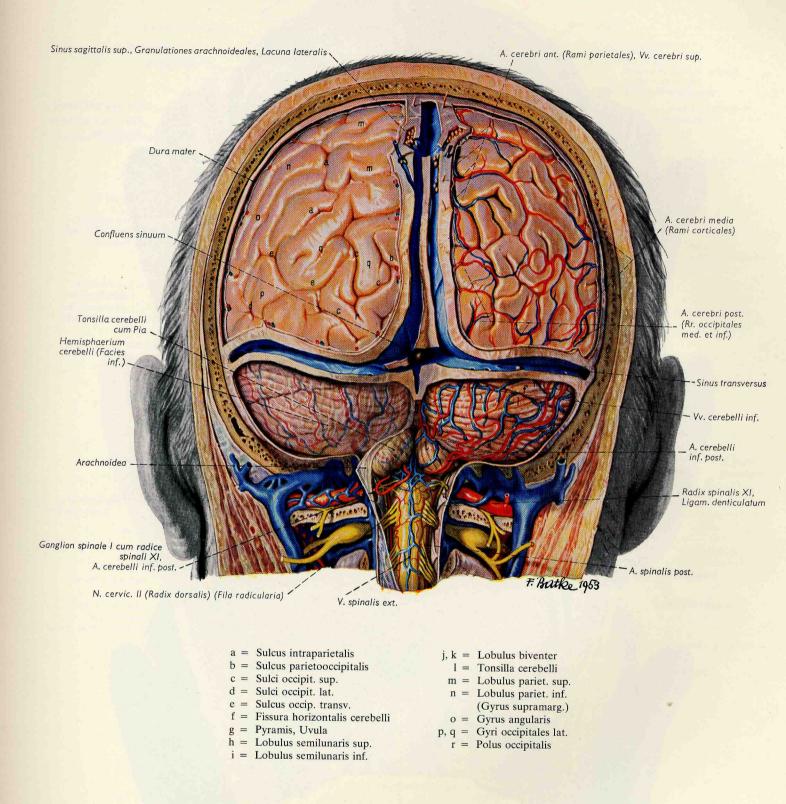


Fig. 53. Telencephalon, cerebellum, medulla oblongata and upper cervical cord seen from behind. The cerebellomedullary cistern has been opened.

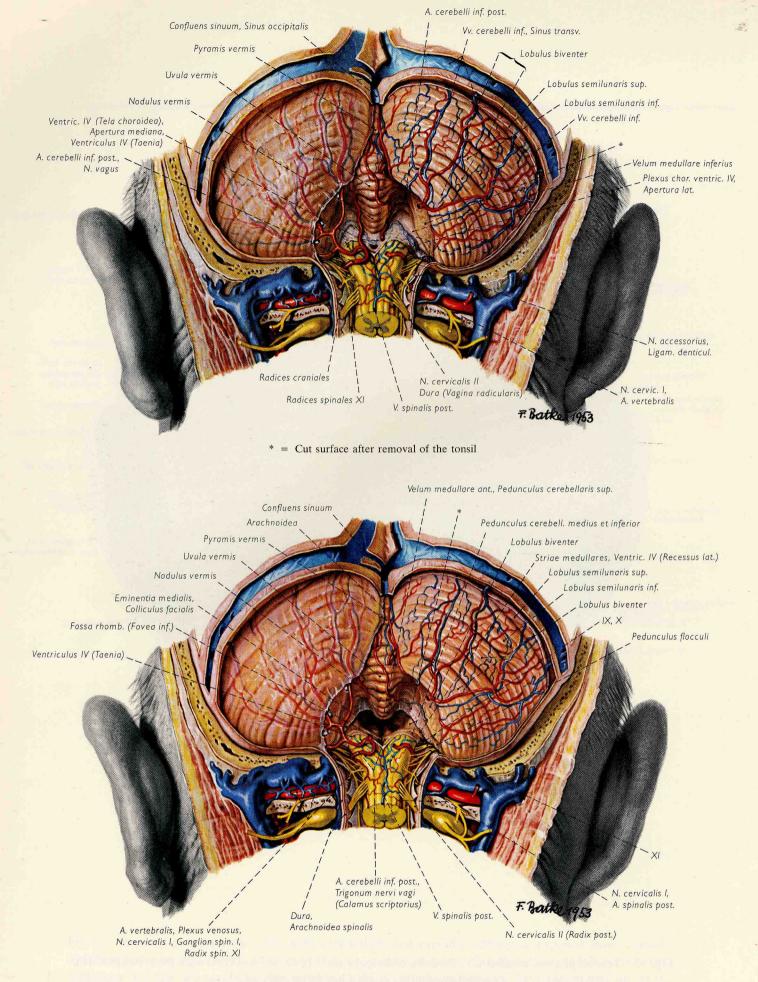


Fig. 54. (Top) Exposure of the under surface of cerebellum, the roof of the fourth ventricle and the medulla oblongata with associated vessels and nerves, from behind.

Fig. 55 (Bottom) View as in Fig. 54, but the choroid layer of the fourth ventricle has been removed so that the ventricle and the outline of the rhomboid fossa may be seen.

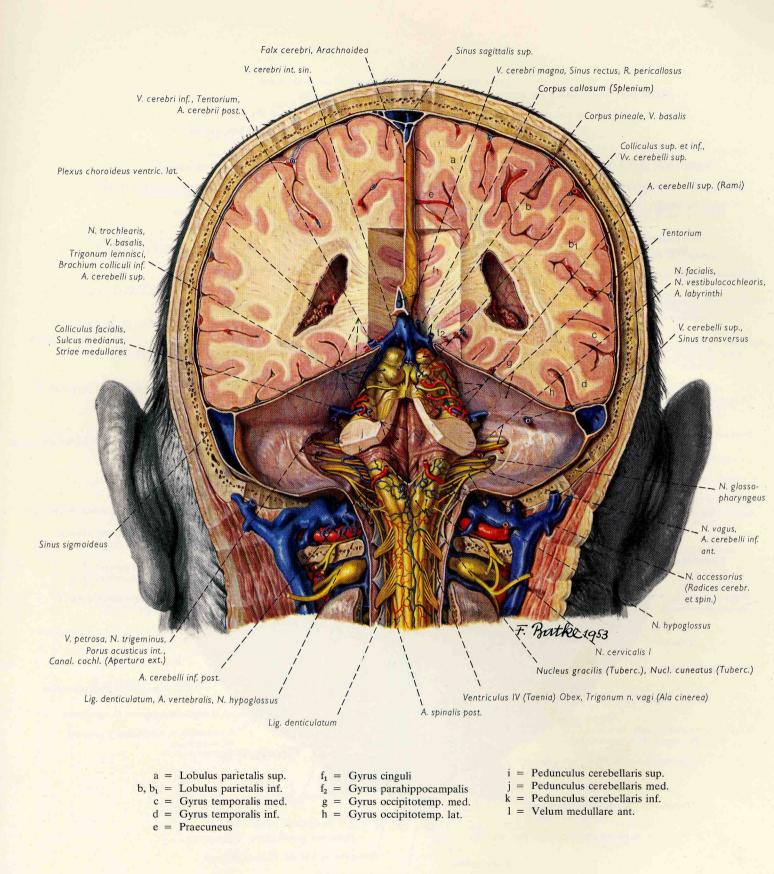
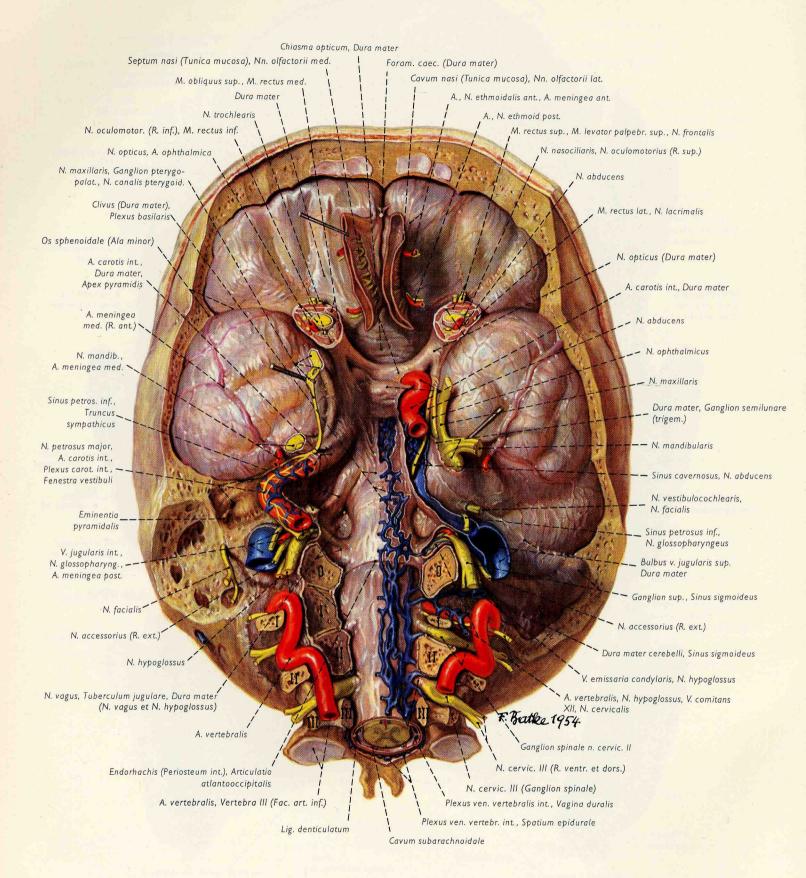


Fig. 56. Exposure of the brain stem and the upper cervical cord from behind. Cerebellum has been removed at the level of its peduncles. View into the subtentorial space and the rhomboid fossa.



Number code as in Fig. 58.

Fig. 57. Exposure of the dura mater at the base of the skull.

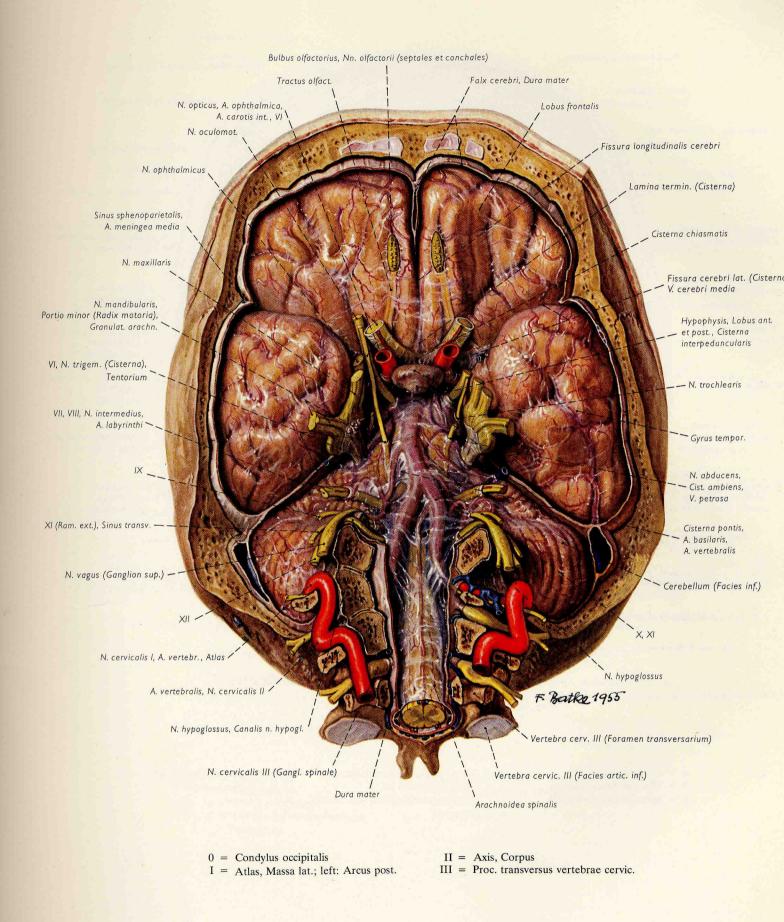


Fig. 58. Anterior, inferior view of the brain and the cervical cord with an intact arachnoid membrane. The basal cisterns. Note the passage of the cranial nerves through the funnel-like extensions of the arachnoid, and the trigeminal cistern that forms an outpocketing toward the semilunar ganglion.

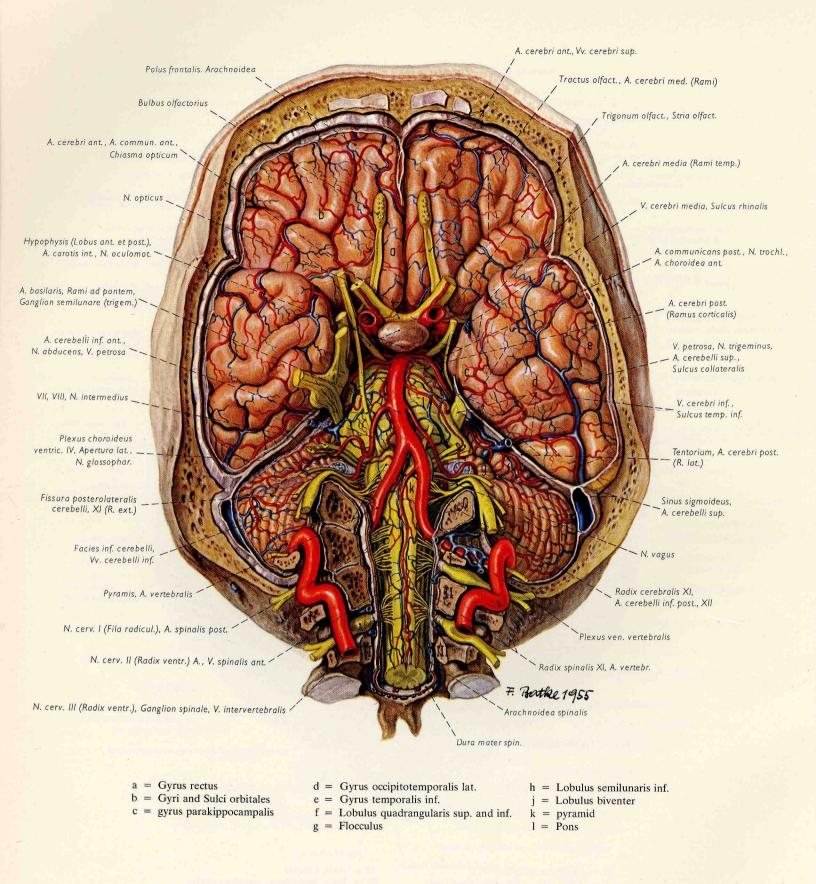


Fig. 59. View of brain from the base of the skull. The arachnoid has been removed and the basal cisterns have been opened so that vessels and nerves at the base of the brain can be seen.

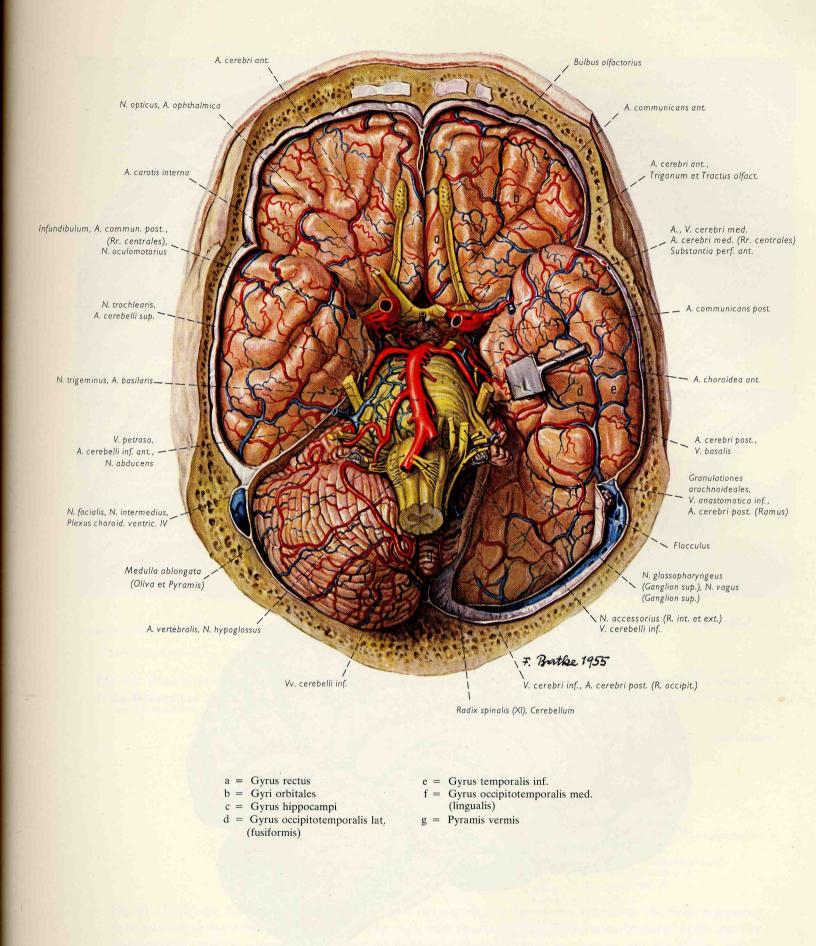
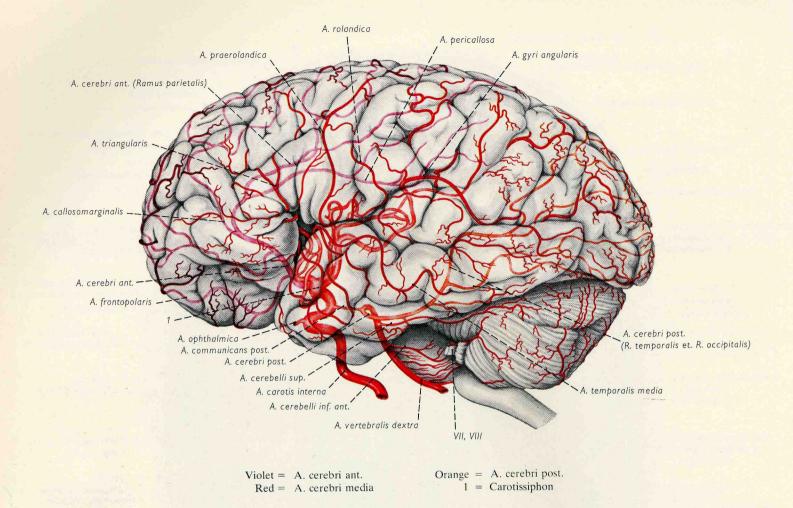
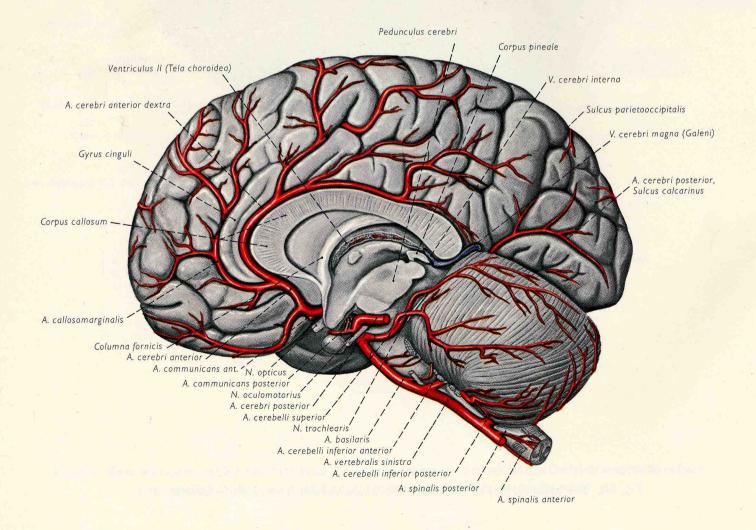


Fig. 60. The basal surface of the brain with blood vessels. The cerebral arterial circle.





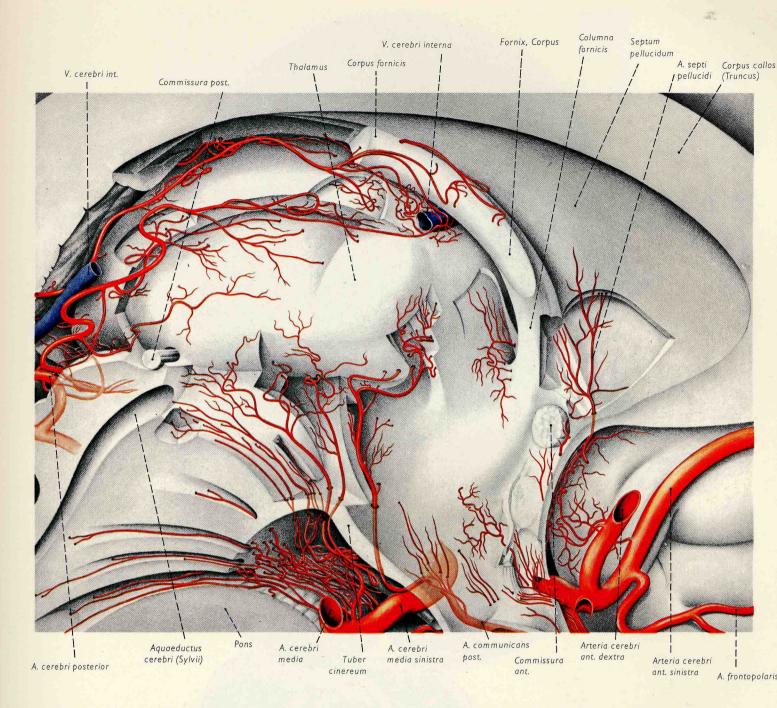


Fig. 63. Arteries of the human upper brainstem, in particular those of the basal ganglia. Medial view of left hemisphere. Note the origin of 10–20 central perforating arteries from the middle cerebral artery and their entrance into the posterior perforated substance (injection preparation by H. Ferner and W. Trost).

Fig. 61. (Left, top) Lateral view of the arteries of the left hemisphere. Injection preparation. The brain is depicted as translucent so that a direct comparison may be made with an arteriogram. The terminal branches of the anterior and posterior cerebral arteries curve around the borders of the hemisphere to continue onto the convex surface (after Ferner/Kautzky in: Handbuch der Neurochirurgie, Vol. 1, Berlin–Heidelberg–New York, 1959).

Fig. 62. (Left, bottom) Arteries on the medial aspect of the cerebrum (right hemisphere) and the surface of cerebellum. Left hemisphere has been removed. Medial view (after Sobotta/Becher).

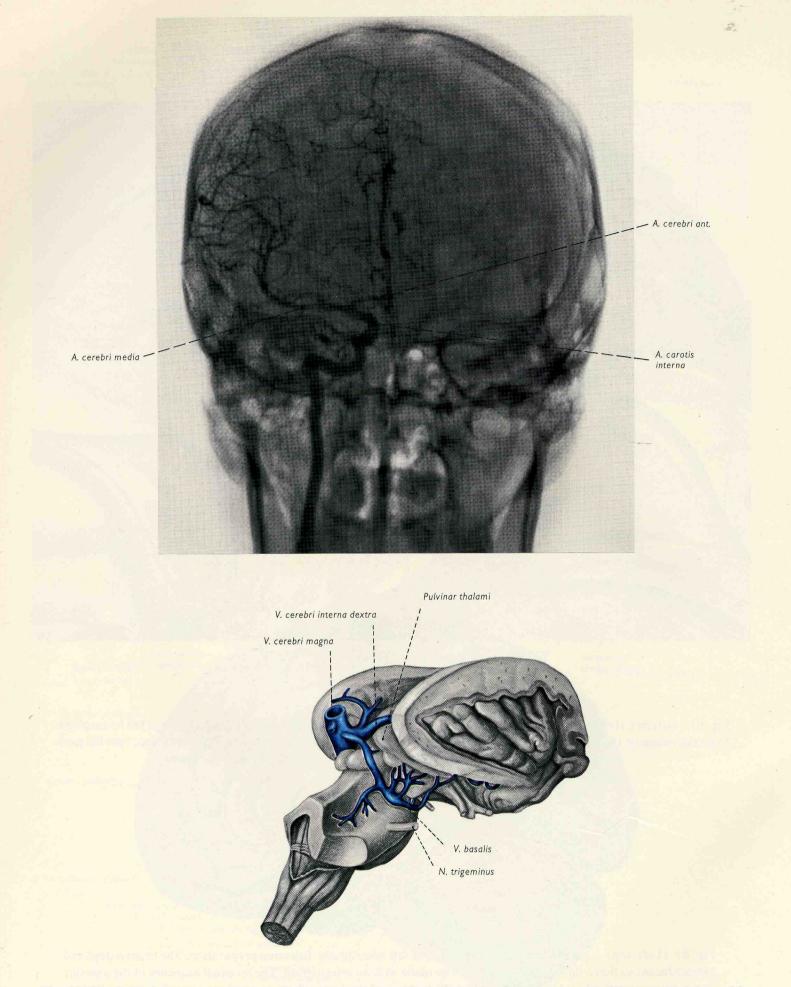


Fig. 64. (Top) Right anteroposterior carotid angiogram. Note the T-shaped branching at the end of the carotid siphon with the anterior cerebral a. going medially and the middle cerebral a., laterally. The terminal branches of the ant. cerebral a. curve around the border of the hemisphere to continue on the convex surface.

Fig. 65. (Bottom) Vena basalis (of Rosenthal) and Vena cerebri magna (of Galen) [after Toldt/Hochstetter].

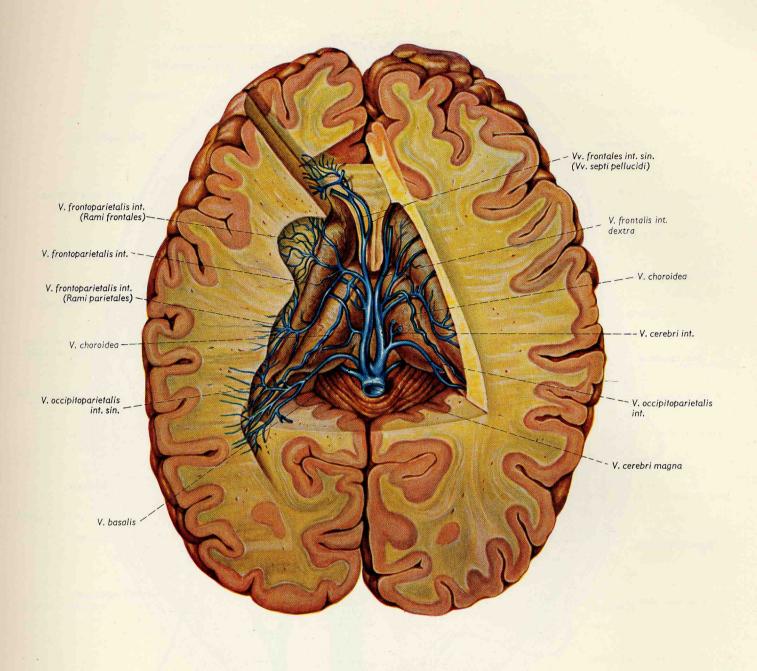


Fig. 66. The internal cerebral veins and their tributaries; left: typical, right: variation.

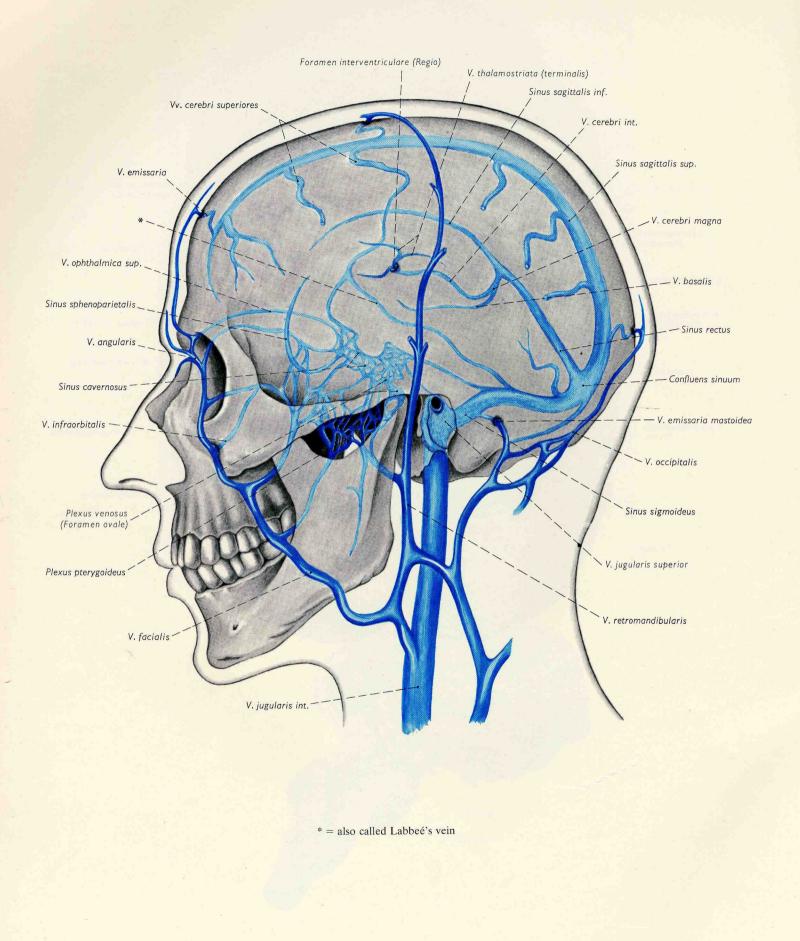


Fig. 67. Venous trunks of the head, and dural sinuses with anastomoses between the venous networks. The dural sinuses and veins obscured by bone are drawn on a translucent skull (after Ferner/Kautzky in: Handbuch der Neurochirurgie, Vol. 1, Berlin–Heidelberg–New York, 1959).

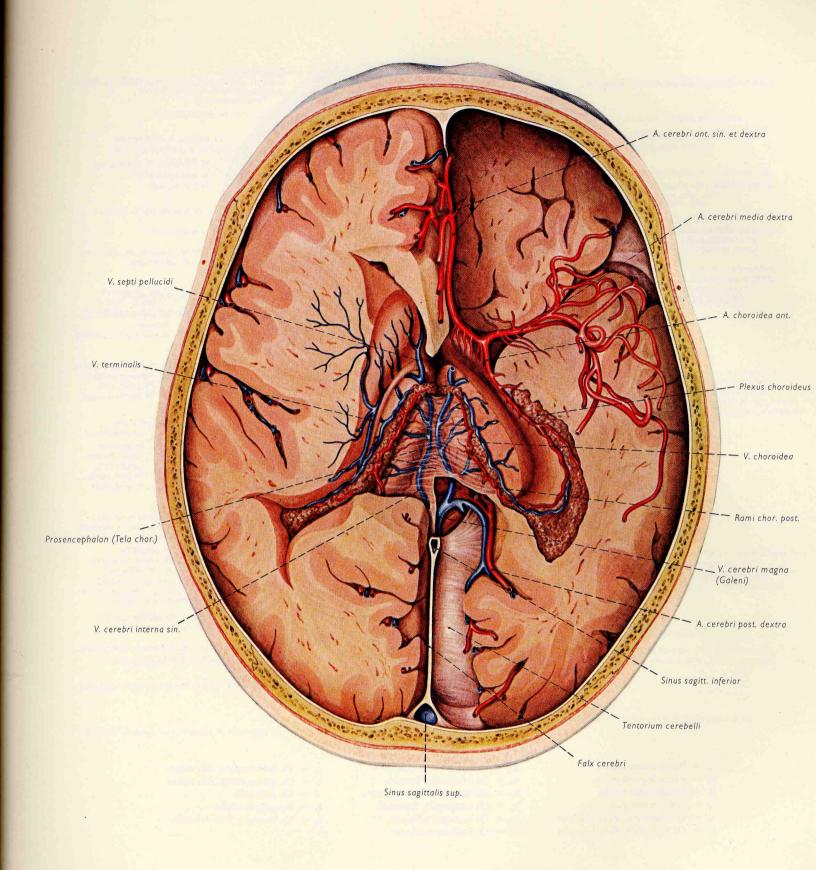


Fig. 68. Horizontal section of the brain with the branching and distribution of the anterior, middle and posterior cerebral arteries. Location and course of the deep cerebral veins.

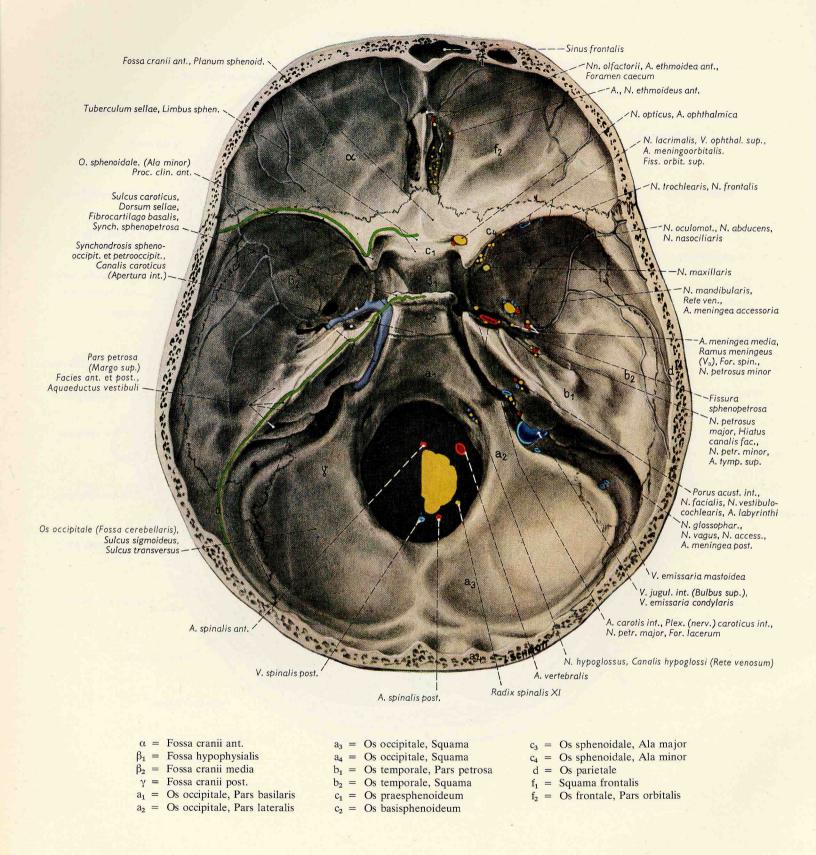


Fig. 69. Base of the cranium seen from the inside. The three cranial fossae are separated by green lines; on the right, vessels and nerves are indicated where they pass through foramina.

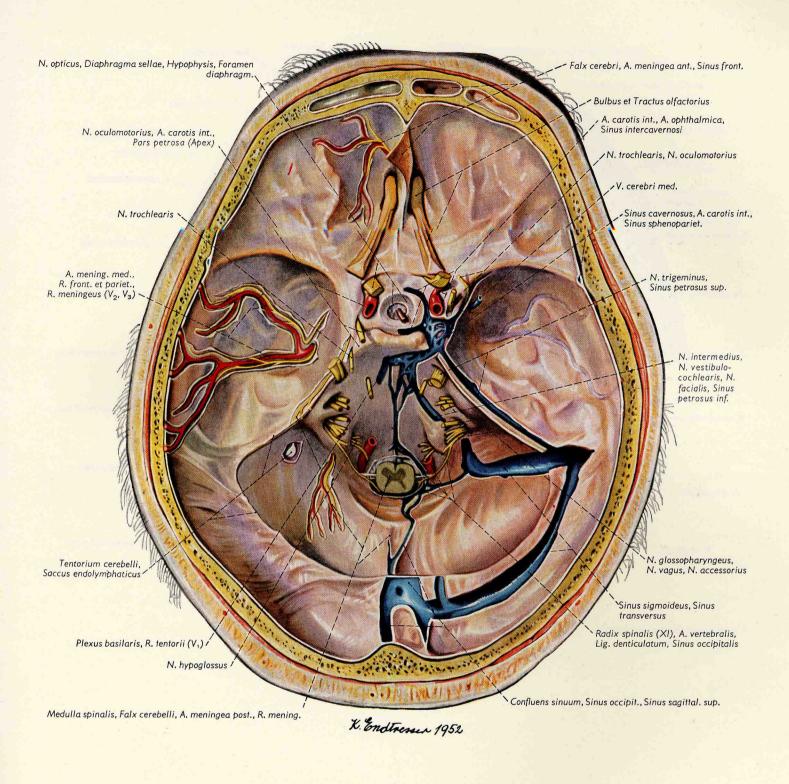


Fig. 70. Base of skull from the inside. Dural vessels and nerves (on left side); opened dural sinuses (on right side).

Fig. 71. The arteries of the brain and the cerebral arterial circle (of Willis) and their topographical relationship to the base of the skull and tentorium. The left hemisphere has been removed, and only portions of the occipital and temporal lobes remain on the right. The basal artery and the tentorial notch. The right posterior cerebral artery arises from the internal carotid artery (frequent variation) (drawn by K. Endtresser from an illustration in Ferner/Kautzky in: Handbuch der Neurochirurgie, Vol. 1, Berlin–Heidelberg–New York, 1959).

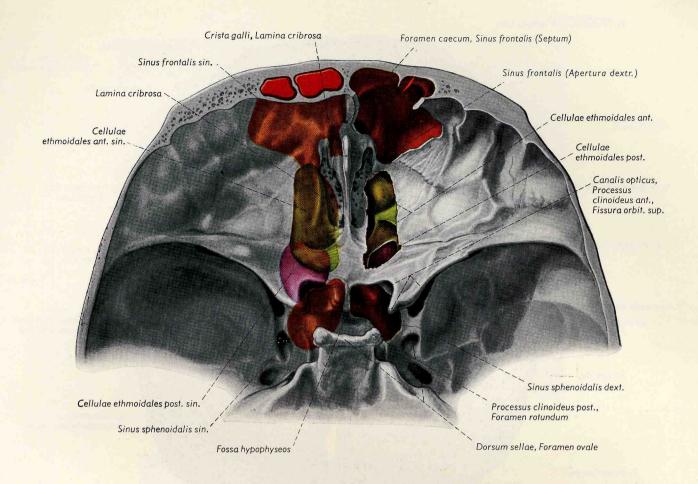


Fig. 72. The paranasal sinuses shown in different colors, viewed from above. On the left side the sinuses are projected on the bone (transparent) of the skull base. On the right, the cavity and floor of the sinuses have been brought into view by partial removal of the overlying bone.

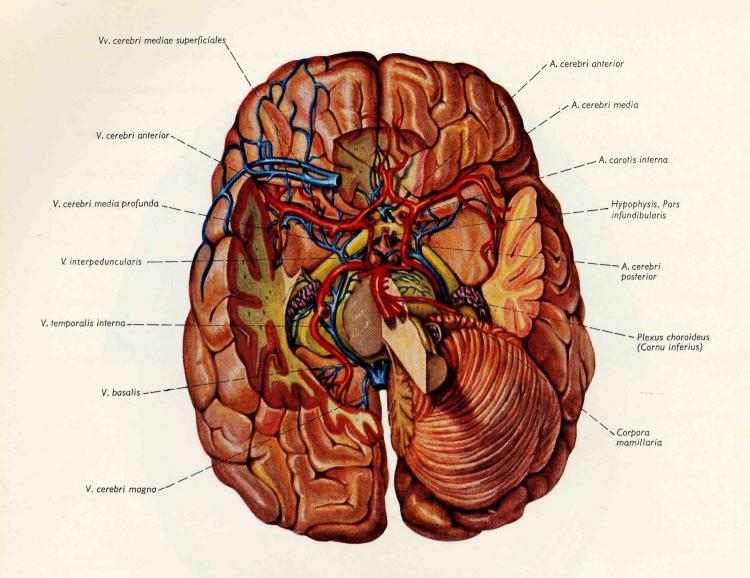
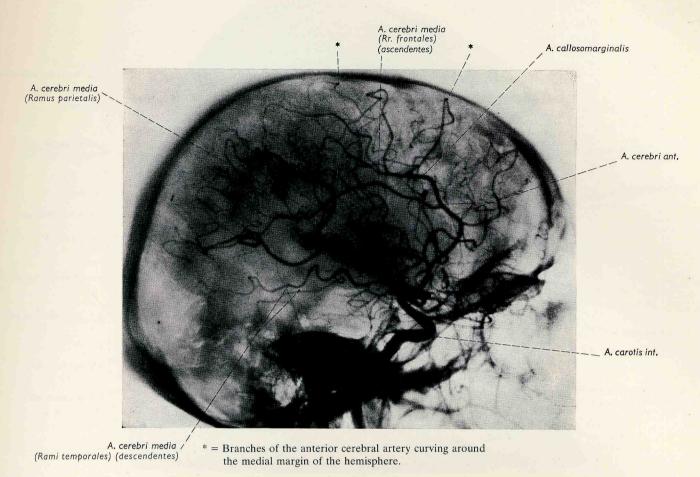


Fig. 73. The basal vein on the inferior surface of the brain with its anastomoses and tributaries. Part of the drainage pattern of the basal vein is in the form of a circulus venosus in the region of the chiasm, formed by connections between the anterior cerebral, the middle (deep) cerebral and the interpeduncular veins. The vein that drains the deep portion of the inferior horn (left side of the picture) is called the "internal temporal vein." Note also the superficial middle cerebral vein (drawn by K. Endtresser from an illustration in Ferner/Kautzky in: Handbuch der Neurochirurgie, Vol. 1, Berlin–Heidelberg–New York, 1959).



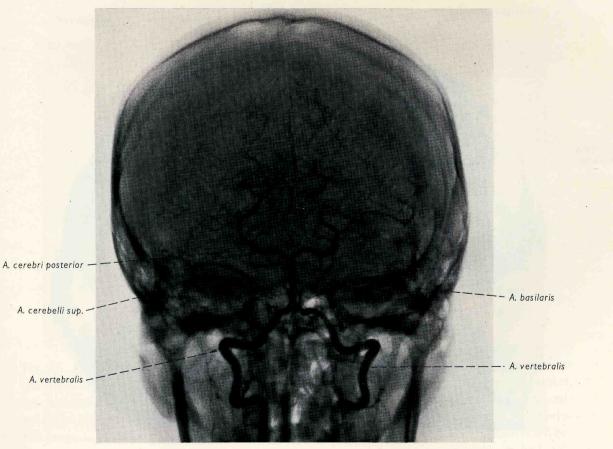


Fig. 74. (Top) Normal internal carotid arteriogram, lateral view (R. Kautzky, Div. of Neurosurgery, University of Hamburg).

Fig. 75. (Bottom) Frontooccipital vertebral arteriogram (R. Kautzky, Div. of Neurosurgery, University of Hamburg).

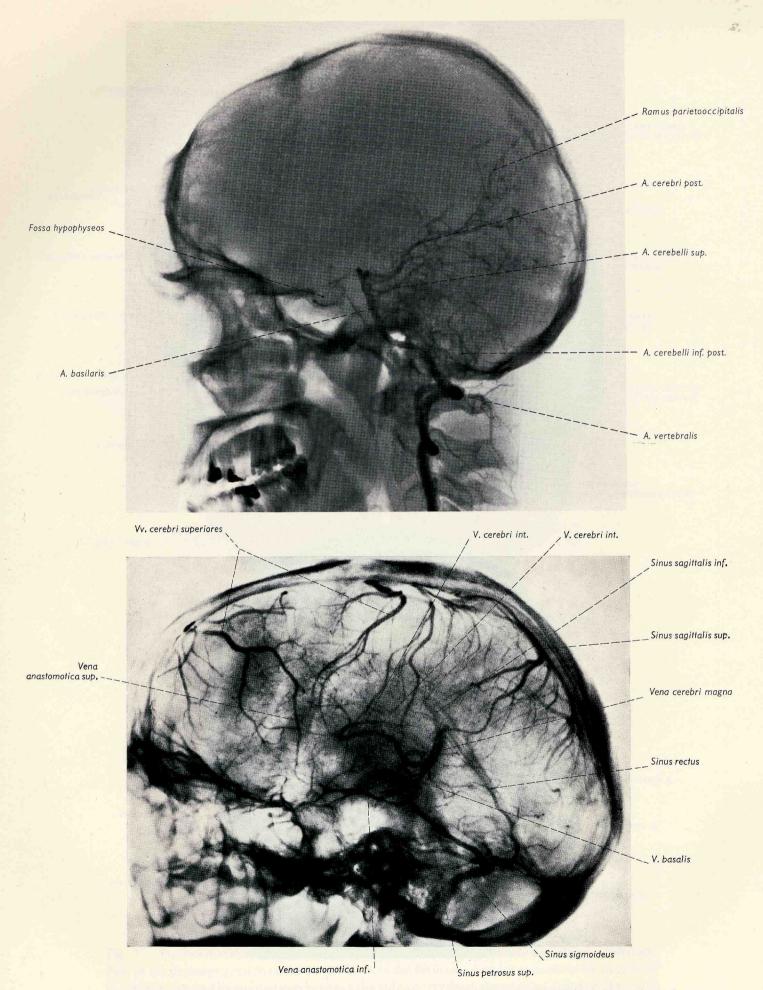


Fig. 76. (Top) Normal vertebral arteriogram, lateral view (from Kautzky/Zülch in: Neurologischneurochirurgische Röntgendiagnostik, Berlin-Heidelberg-New York, 1955).

Fig. 77. (Bottom) Late phlebogram, lateral view (from Kautzky/Zülch in: Neurologisch-neurochirurgische Röntgendiagnostik, Springer, Berlin-Heidelberg-New York, 1955).

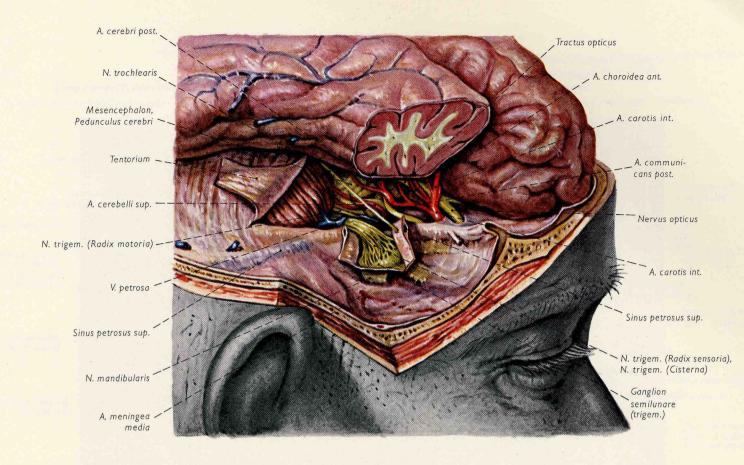


Fig. 78. Lateral view of the midbrain and the cerebral arterial circle after elevation of the temporal lobe. By reflecting back a portion of the tentorium and opening the dural trigeminal pocket, it is possible to see the rostral end of pons, the right brachium pontis with the root of the trigeminal nerve (portio major and minor) and also the relationship of the trigeminal root to the semilunar ganglion. By opening the dural trigeminal pocket, the superior petrosal sinus is transected because of its course over the trigeminal nerve. The superior petrosal sinus receives, immediately posterior to the trigeminal nerve, a vein from the cerebellum (petrosal v.) into which opens the basal vein from the front (frequent variation). The petrosal vein runs between the sensory and motor roots of the trigeminal nerve. The anterior cerebral artery is seen originating above the chiasm (drawn by K. Endtresser from an illustration in Ferner/Kautzky, in: Handbuch der Neurochirurgie, Vol. 1, Berlin–Heidelberg–New York, 1959).

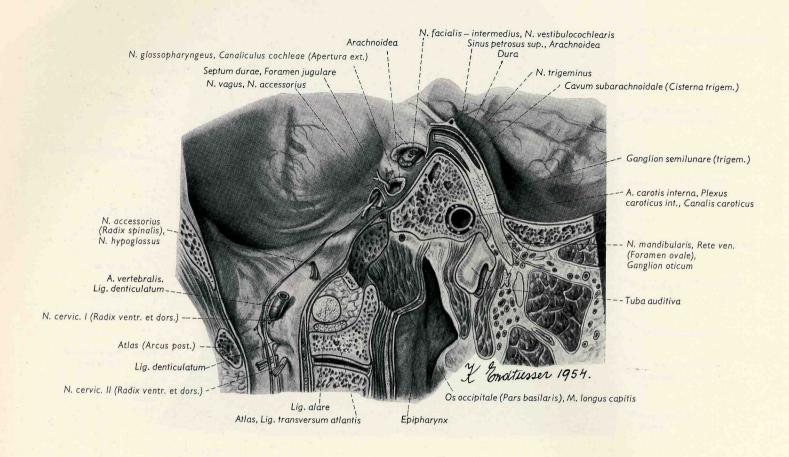


Fig. 79. Section through the base of the skull showing the left cavum trigeminale (Meckel's cavity) and the trigeminal cistern. The plane of this section is left parasagittal in the area of the vertebral canal, then becomes oblique pointing laterally, and near Meckel's cavity is at right angle to the axis of the pyramid.

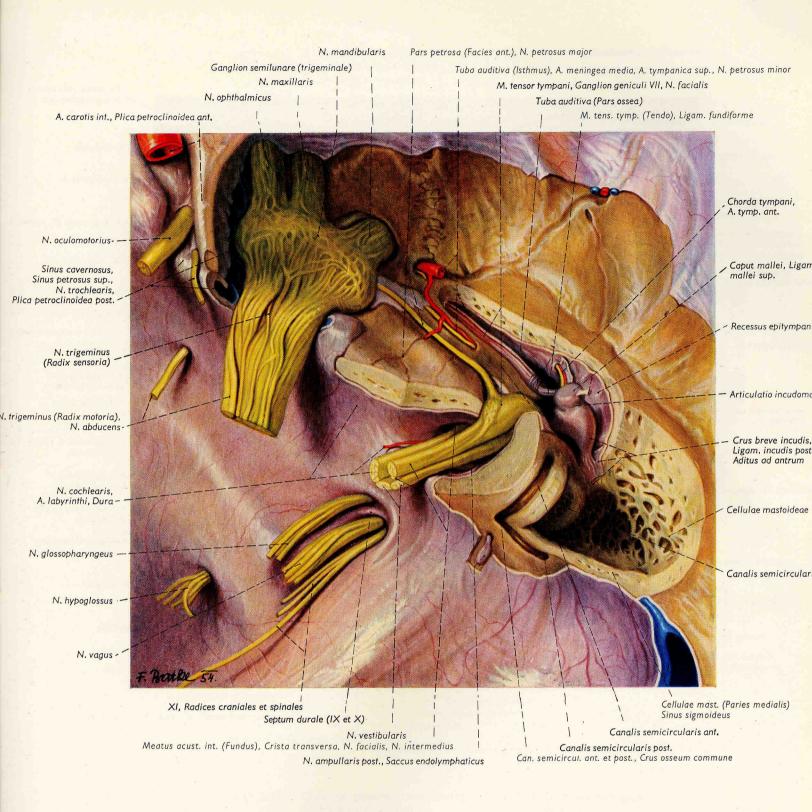


Fig. 80. Area of the semilunar ganglion (of Gasser) and the geniculate ganglion of the facial nerve. View into the tympanic cavity after removal of tegmen tympani.

Fig. 81. Blood vessels and nerves in the middle portion of the skull base, particularly in the region of sella turcica.

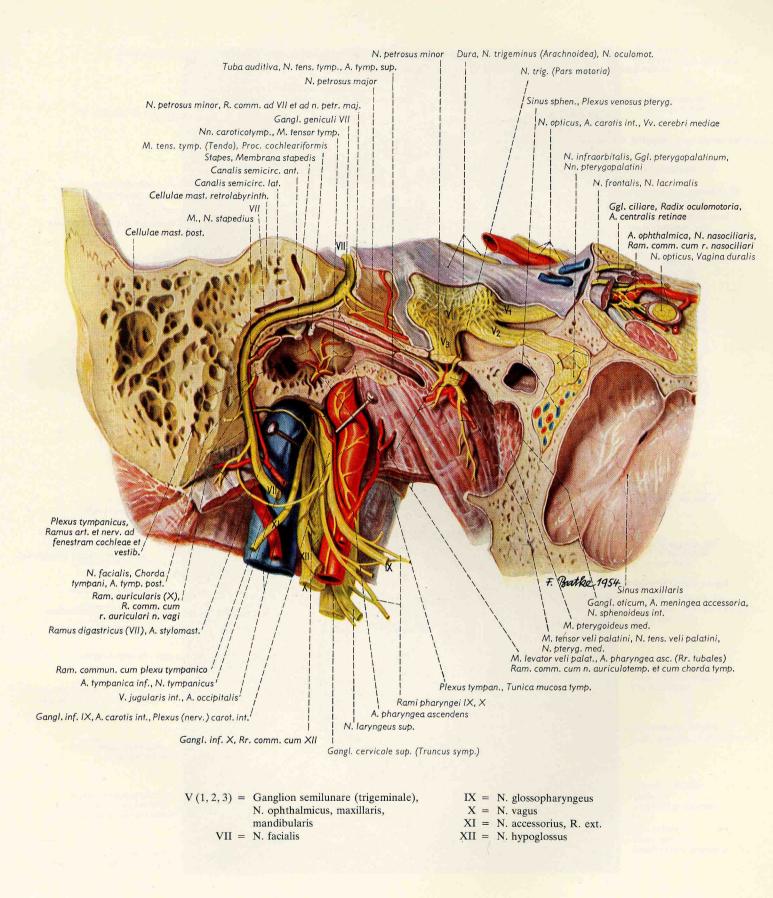


Fig. 82. Lateral view of vessels and nerves of the right middle ear, on the medial wall of the tympanic cavity and in adjoining areas in front and behind. Structures in the middle cranial and infratemporal fossae; exposure of the cervical neurovascular bundle. Lateral view of the opened facial canal, the anterior and lateral semicircular canals and the musculotubal canal. The auditory part of the skull has been cut in an oblique-sagittal plane extending medially from the eardrum, so that the stirrup remains in contact with the medial wall of the tympanic cavity.

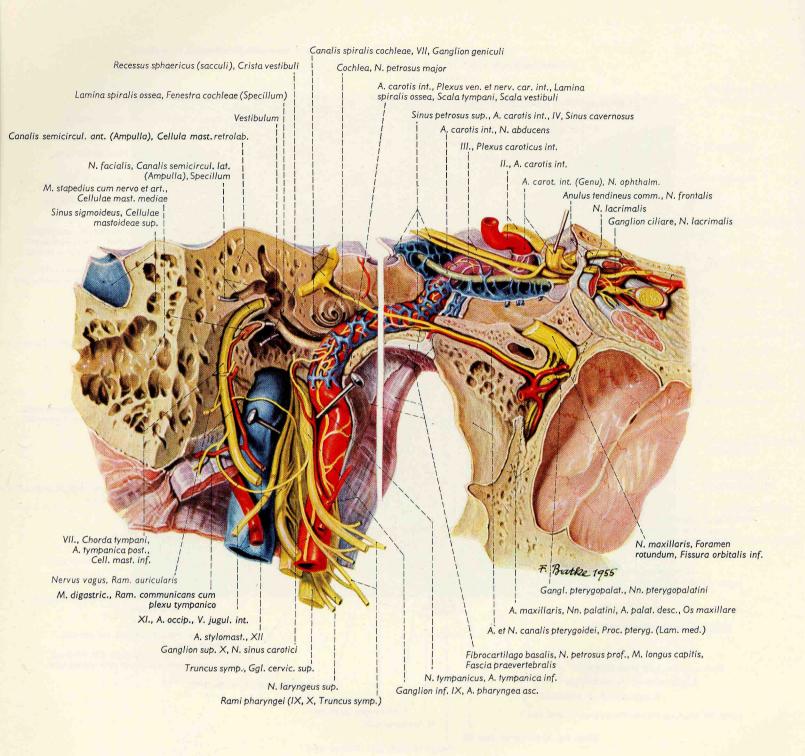
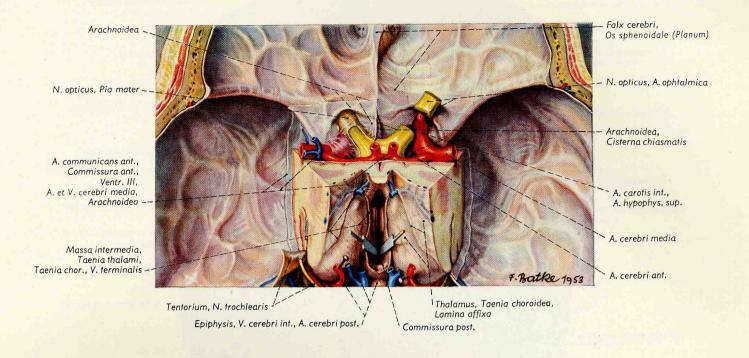


Fig. 83. Vertical section through the petrosal bone along the axis of the pyramid. Opened inner ear, facial canal, mastoid air cells, carotid canal, superior orbital fissure and foramen rotundum.

Course of the internal carotid artery through the petrosal bone.



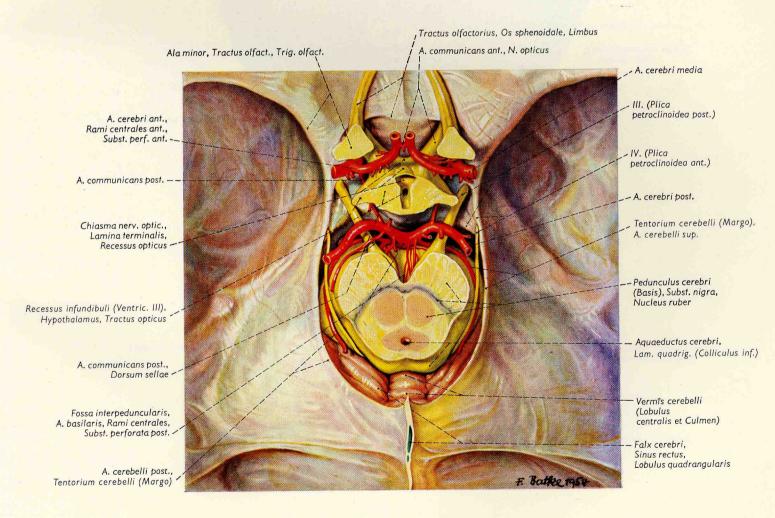


Fig. 84. (Top) Region of the optic chiasm, diencephalon from above, anterior and middle cranial fossae.

Fig. 85. (Bottom) Cross section of mesencephalon viewed through the tentorial notch from above. Region of optic chiasm, cerebral arterial circle.

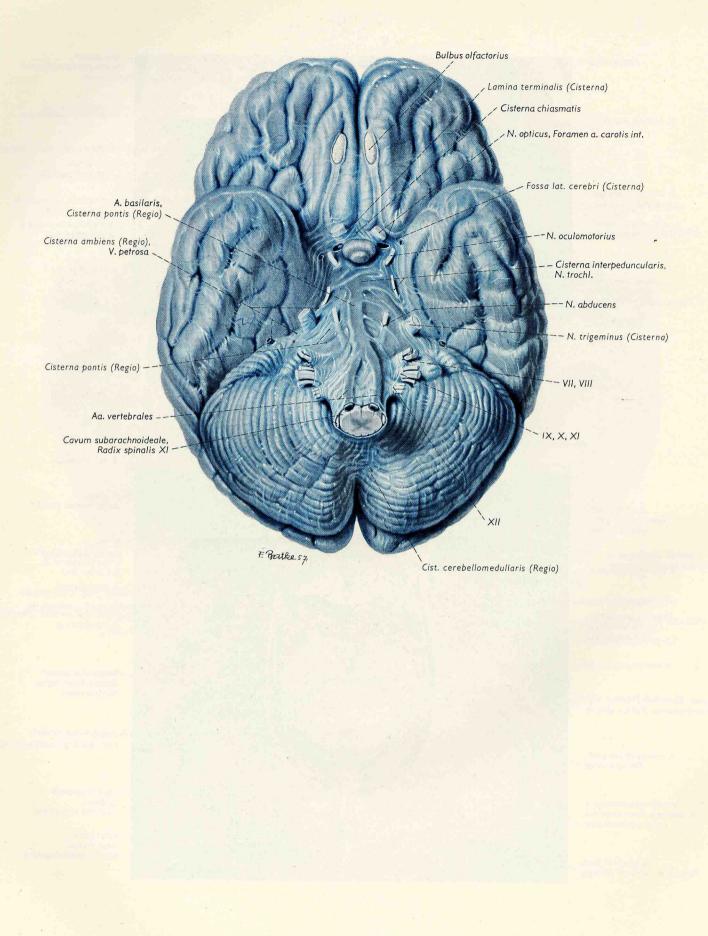
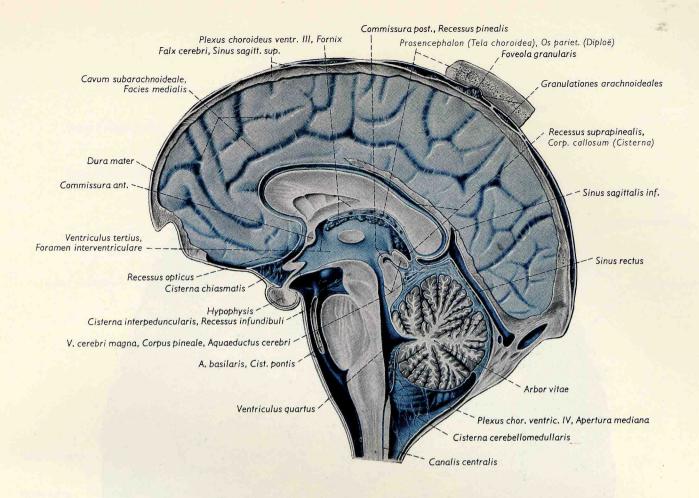


Fig. 86. The arachnoid and subarachnoid space on the inferior aspect of the brain. Note the openings for passage of blood vessels and cranial nerves.



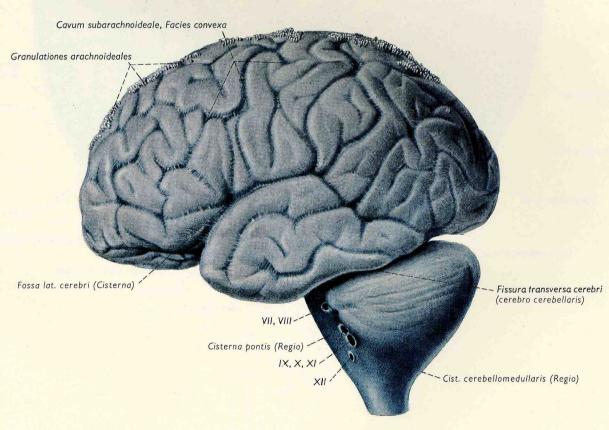


Fig. 87. (Top) The arachnoid and the subarachnoid space; particularly the cisterns, in median section (semischematic). Fluid-filled spaces are colored blue. Blood vessels are included only where they have a specific relationship to the cisterns.

Fig. 88. (Bottom) Lateral view of the arachnoid, the subarachnoid space and the cisterns of the brain (semischematic). Fluid-filled spaces are colored blue.

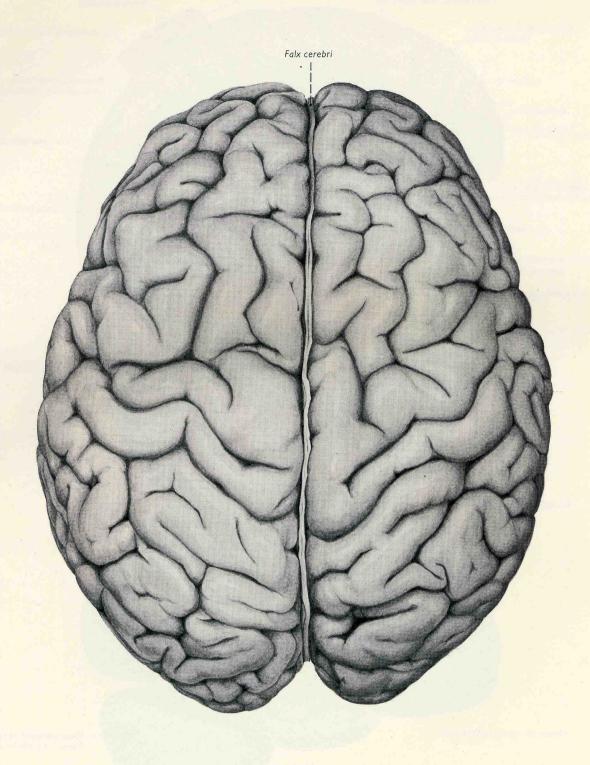


Fig. 89. Superior surface of the cerebral hemisphere after removal of the meninges. Only falx cerebri remains in the longitudinal cerebral fissure. Note, by comparing with Fig. 90, the individual differences in the development of the convolutions and sulci. The identification of a person based on this pattern would be just as accurate as using a fingerprint (dactyloscopy) (prepared by Vieder).

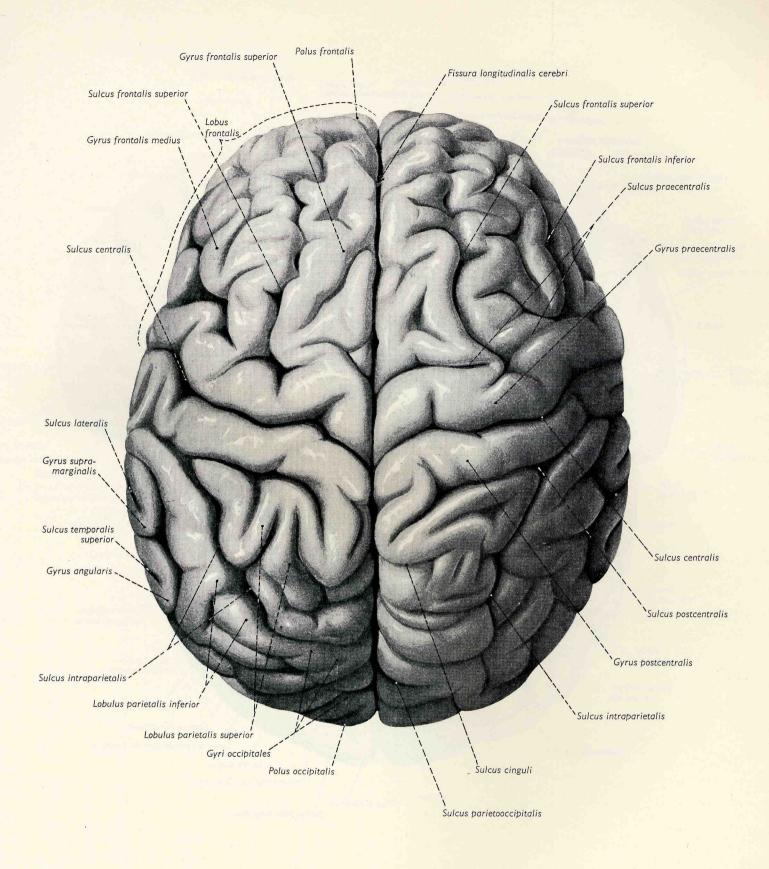


Fig. 90. Cerebral hemisphere after removal of the leptomeninges. Seen from above (from Sobotta/Becher).

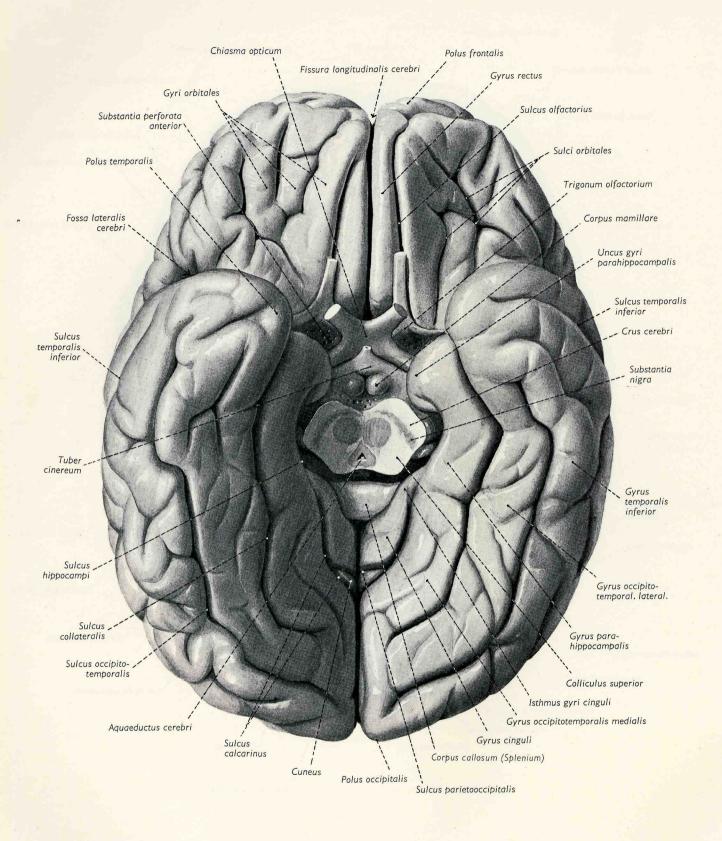


Fig. 91. The cerebral hemisphere after removal of the leptomeninges. Seen from below. The brain stem and cerebellum have been removed by a section through the midbrain. The red nucleus is seen bilaterally under substantia nigra on the cut surface of the midbrain (from Sobotta/Becher).

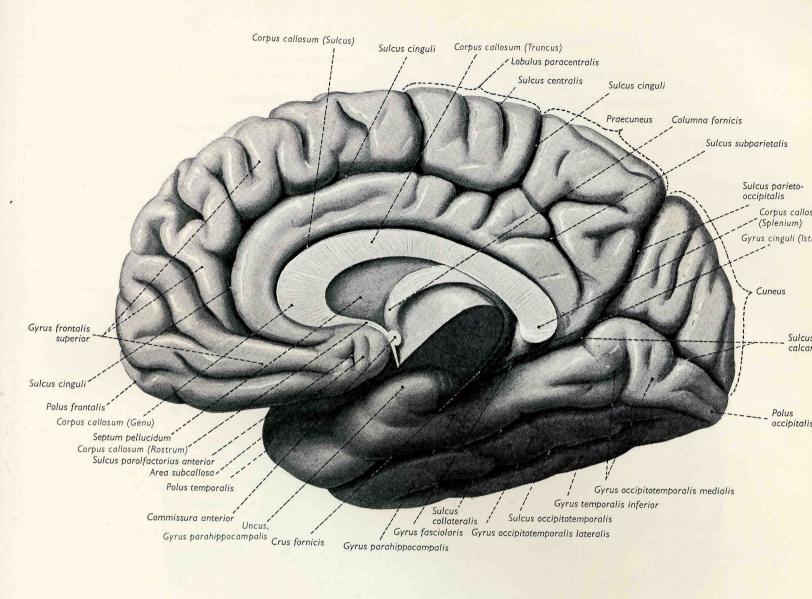


Fig. 92. Right cerebral hemisphere. The brain has been cut in the median plane, and the brain stem and cerebellum have been removed by an oblique section through the diencephalon. View of the medial and inferior surfaces of the hemisphere (from Sobotta/Becher).

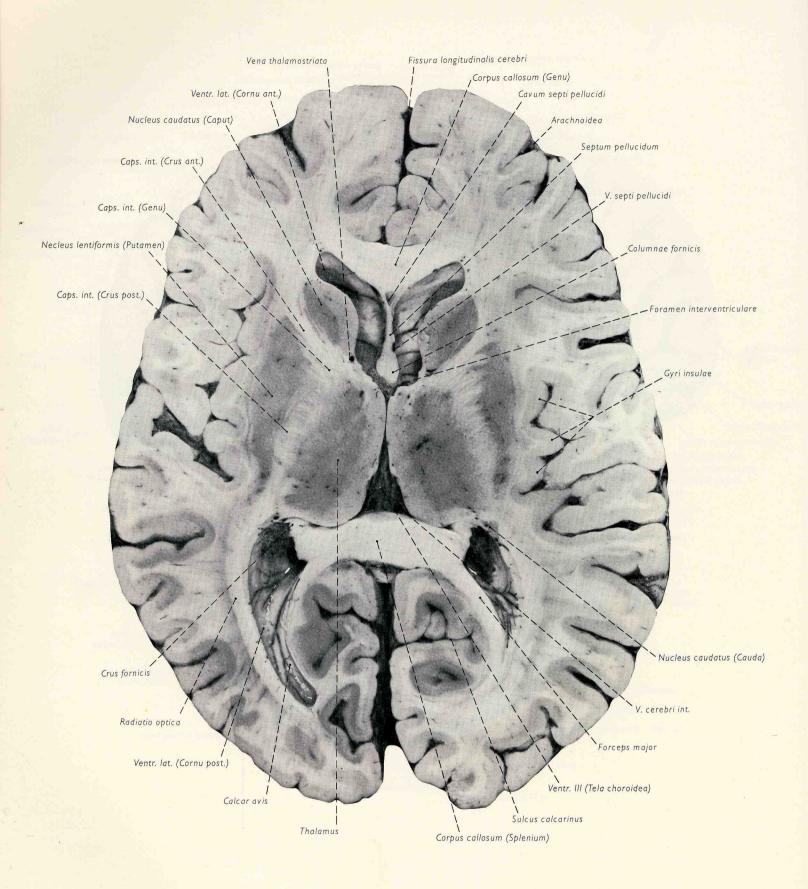


Fig. 93. Horizontal section through the brain, seen from below.

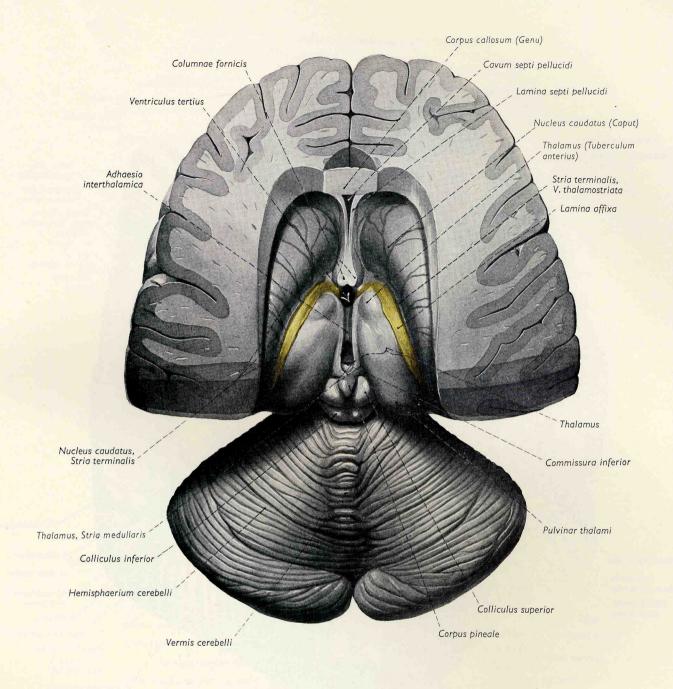


Fig. 94. Basal ganglia of the brain (thalamus and caudate nucleus), third ventricle, lamina quadrigemina and cerebellum seen from above. The columns of the fornix, the chorid lamina of the third ventricle and the temporal and occipital lobes of the hemisphere have been removed. The lamina affixa, which here is the extremely thin wall of the telencephalon, lies on the thalamus and is shown in yellow (from Sobotta/Becher).

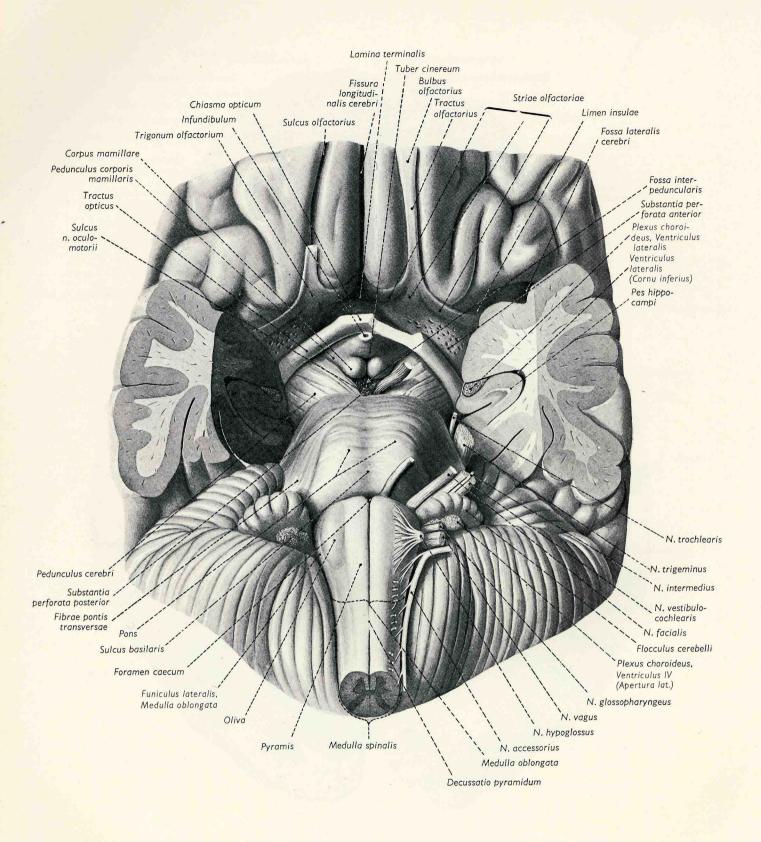
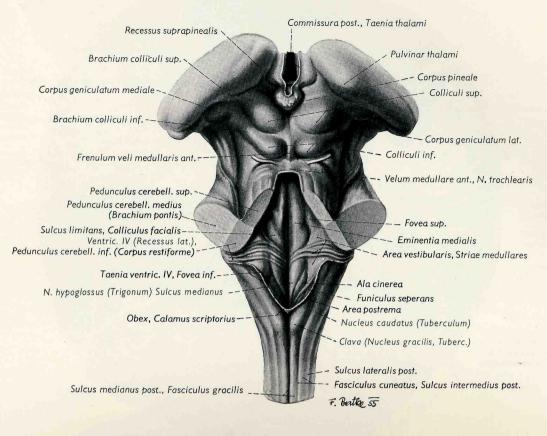


Fig. 95. Brain stem and associated structures of the brain seen from below: diencephalon, midbrain, pons, medulla oblongata (bulb). The temporal poles have been removed. The cranial nerves are retained on the left side and removed on the right. Slightly larger than natural size (from Sobotta/Becher).



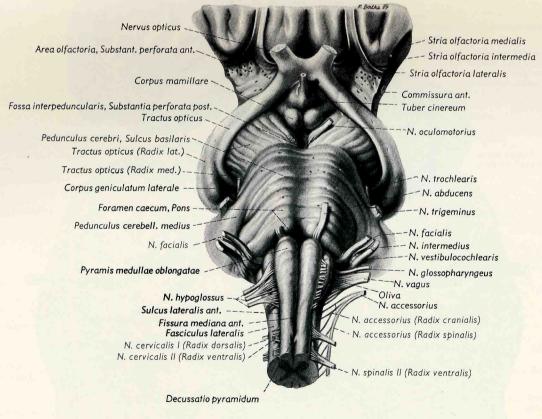


Fig. 96. (Top) Dorsal view of medulla oblongata, rhomboid fossa, cerebellar peduncles and lamina tecti after removal of cerebellum.

Fig. 97. (Bottom) Medulla oblongata, pons, midbrain and diencephalon (brain stem) seen from below.

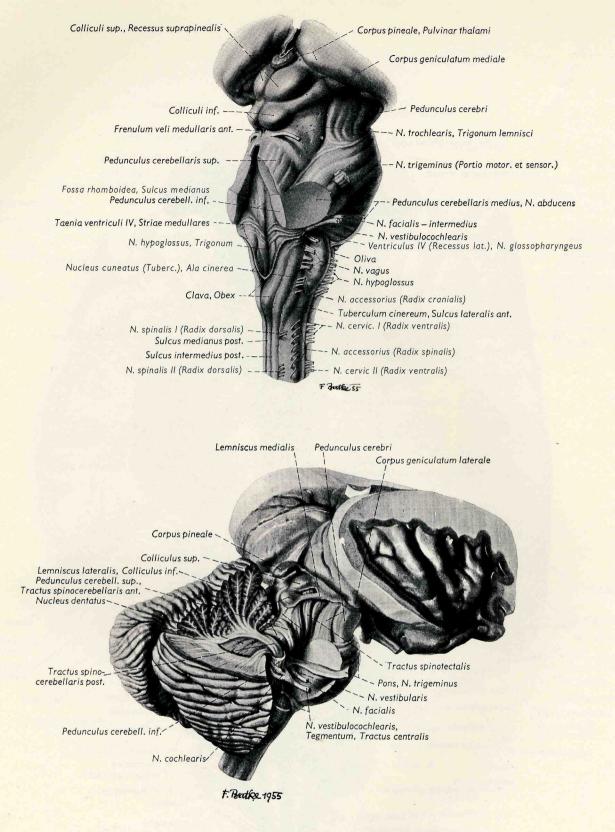


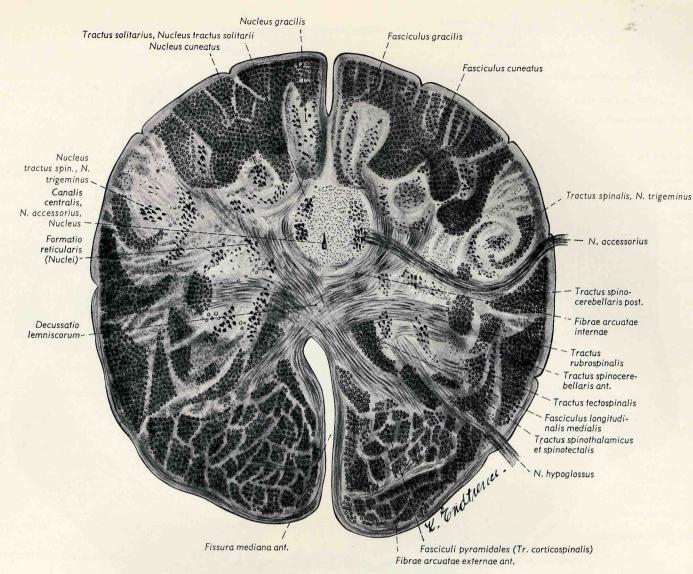
Fig. 98. (Top) Rhombencephalon and midbrain viewed from right side.

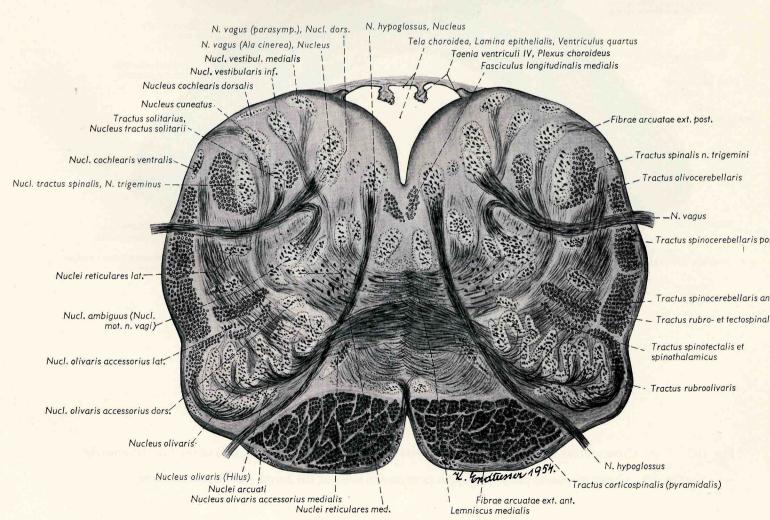
Fig. 99. (Bottom) Dissection of brain stem and cerebellum, from right side.

Demonstration of lemnisci and cerebellar tracts.

Fig. 100. (Right, top) Cross section of medulla oblongata at the level of the lemniscal decussation.

Fig. 101. (Right, bottom) Cross section through medulla oblongata in the lower third of the olive showing nuclei and tracts.





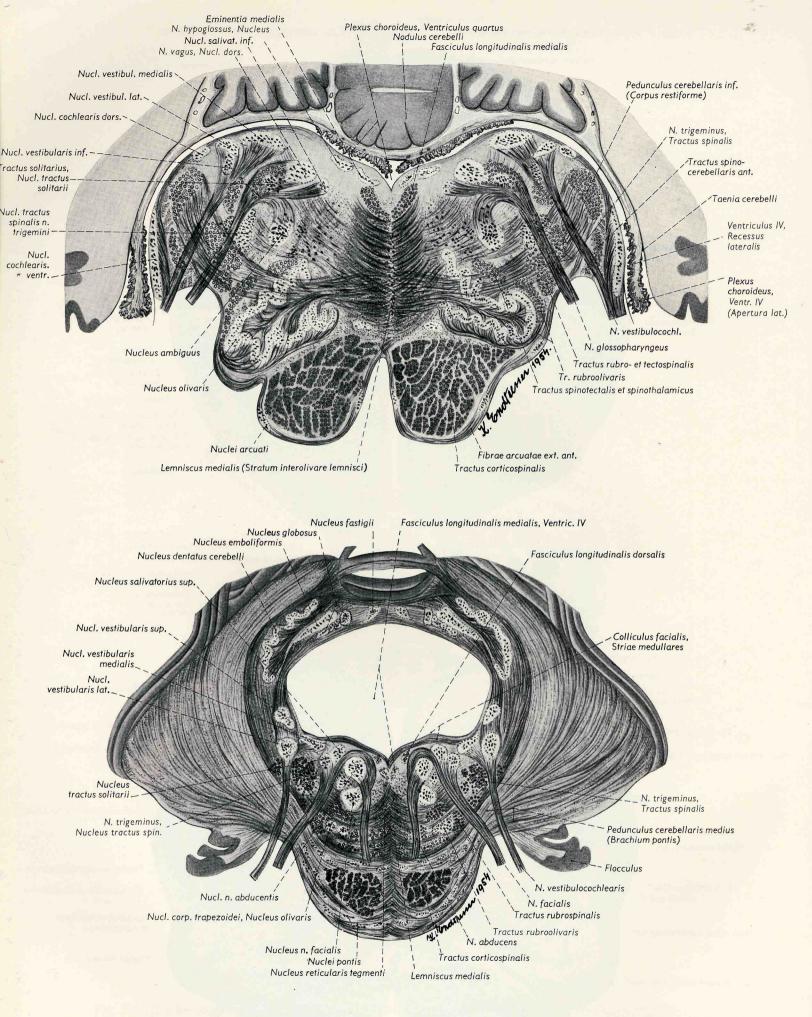
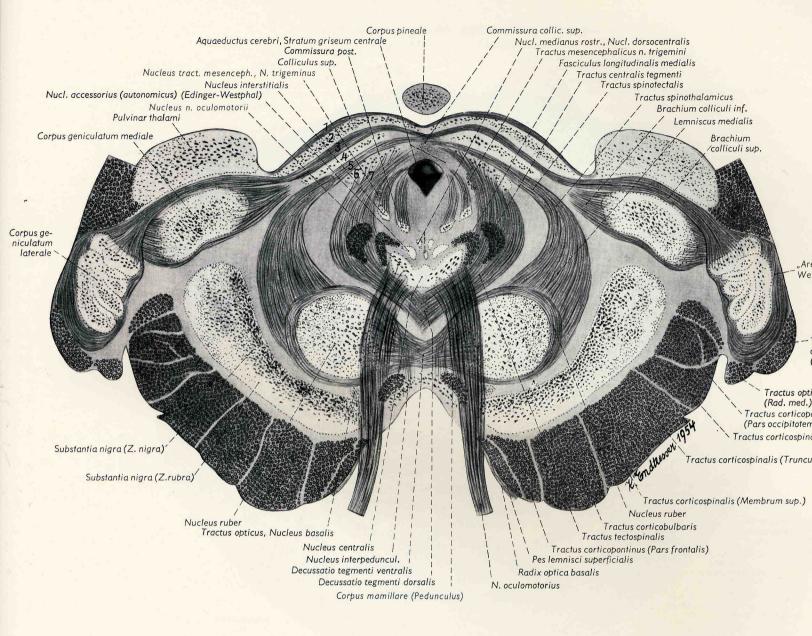


Fig. 102. (Top) Cross section through medulla oblongata at the level of the lateral recess of the fourth ventricle. Fig. 103. (Bottom) Cross section through pons at the level of the facial and abducens nuclei.



Strata of the superior colliculus:

1 = Stratum zonale

2 = Stratum griseum superficiale

3 = Stratum medullare superficiale (Stratum opticum)

4 = Stratum griseum medium

5 = Stratum medullare medium (Stratum lemniscale)

6 = Stratum griseum profundum

7 = Stratum medullare profundum

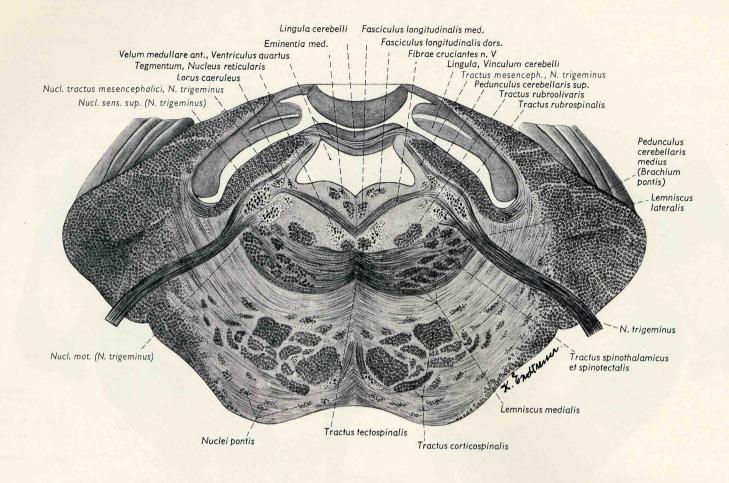


Fig. 105. Cross section of pons at the level of the trigeminal nerve.

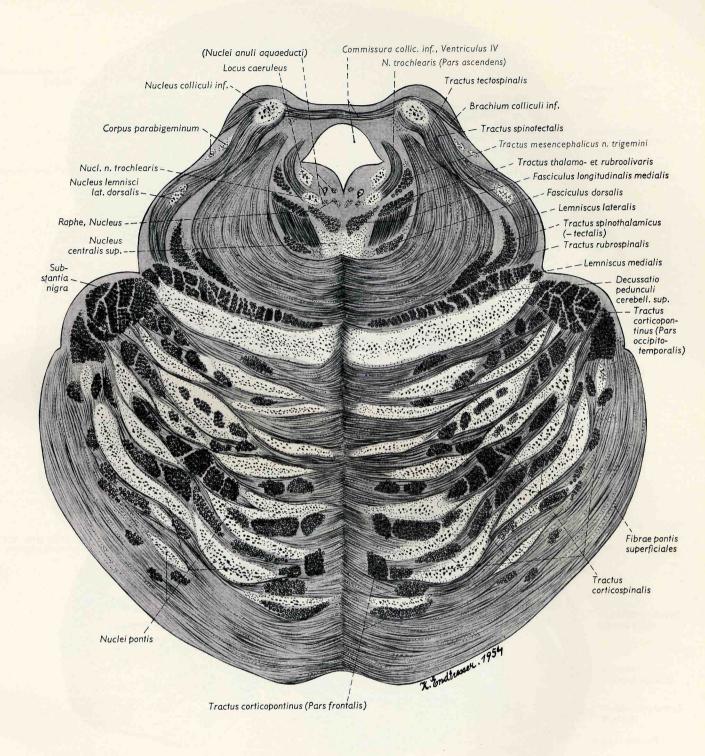


Fig. 106. Cross section of the brain stem at the level of the inferior colliculi.

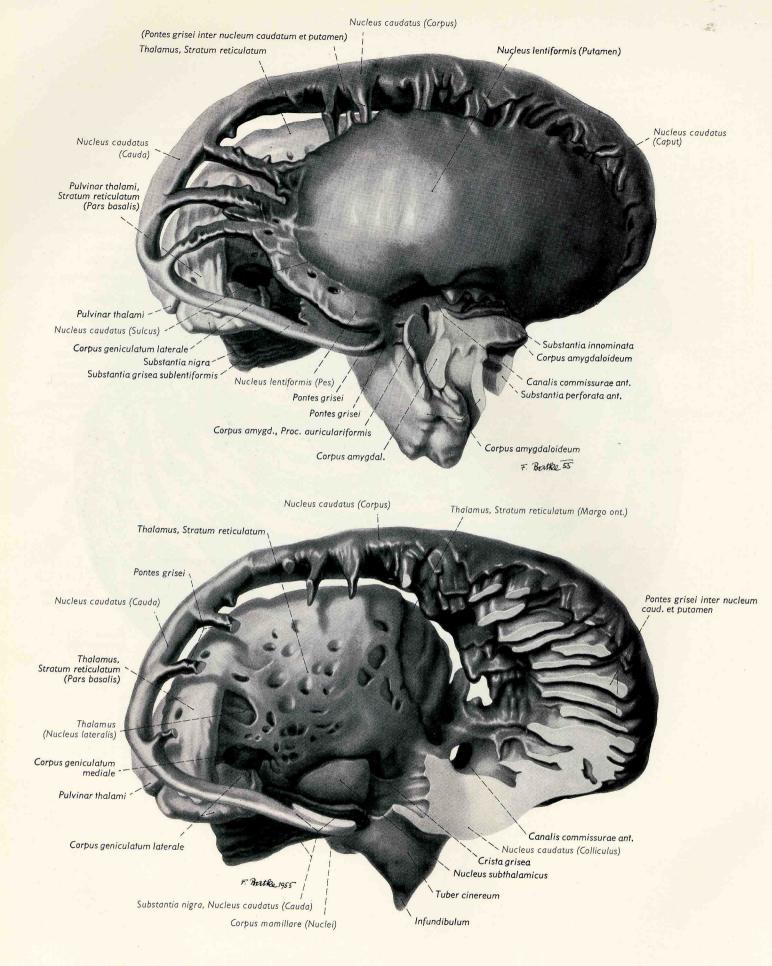


Fig. 107. (Top) Caudate and lentiform nuclei. Lateral view of basal ganglia of right half of brain after removal of claustrum. Drawn from a model.

Fig. 108. (Bottom) Lateral view of the basal ganglia drawn from a model. The lentiform nucleus, amygdaloid body and anterior perforated substance have removed. Lateral view of thalamus and caudate nucleus.

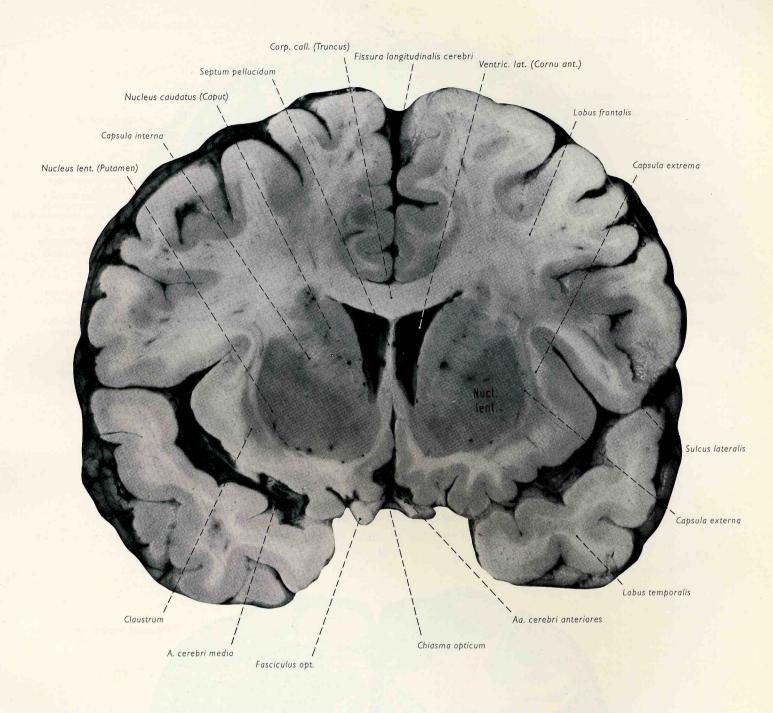
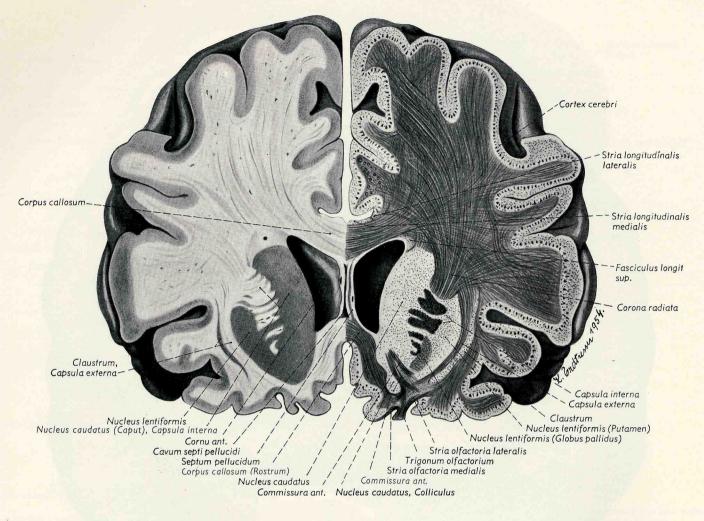
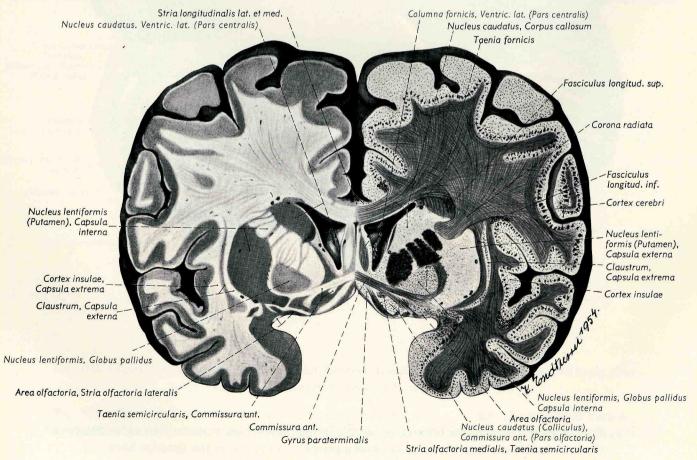


Fig. 109. Frontal section through the brain (prosencephalon) anterior to the thalamus, the optic chiasm and the interventricular foramen. The choroid plexus is not present in the anterior horn.





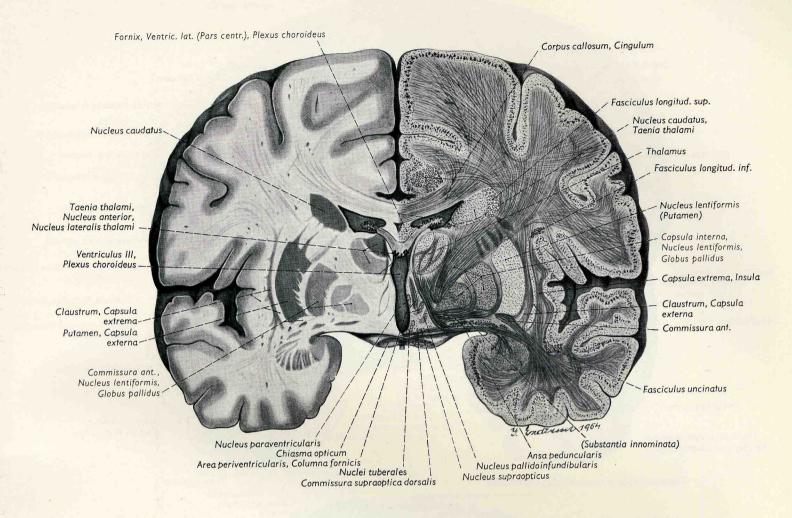
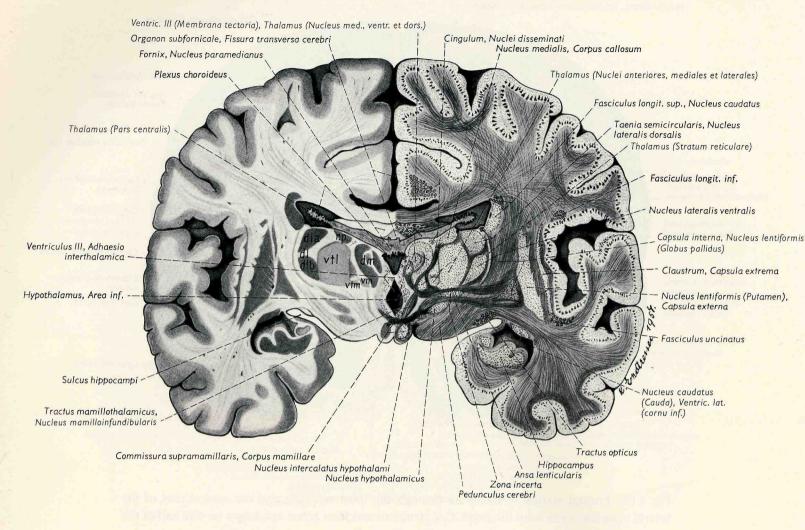


Fig. 112. Frontal section of the brain through the third ventricle and the central part of the lateral ventricle, seen from the front. Cell structure and fiber tracts are drawn on one half of the section.

Fig. 110. (Left, top) Frontal section of the brain through the anterior horn of the lateral ventricle. Cell structure and fiber tracts are drawn on one half of the section.

Fig. 111. (Left, bottom) Frontal section of the brain through the boundary between the anterior horn and the central part of the lateral ventricle, seen from the front. The cut was conducted so that the columns of the fornix were sectioned squarely. Cell structure and fiber tracts are drawn on one half of the section.



Ventral nucleus of thalamus

r. p = Nucleus rostralis principalis,
Nucleus rostralis accessorius,
Nuclei disseminati

vtl = Nucleus ventrolateralis
vtm = Nucleus ventromedialis
vtm = Nucleus ventralis medialis

Ventral nucleus of thalamus

dm = Nucleus dorsomedialis,
Nucleus medialis ventr. (Centr. medianum).
Nucleus medialis dors.

dl = Nucleus dorsolateralis
vtm = Nucleus ventromedialis
dla = Nucleus lateralis dors.

vm = Nucleus ventralis medialis
dlb = Nucleus lateralis ventr.

Fig. 113. Frontal section of the brain viewed from the front. The cut was conducted through the rostral part of the thalamus, the mamillary bodies and the interthalamic adhesion of the third ventricle. Cell structure and fiber tracts are drawn on one half of the section.

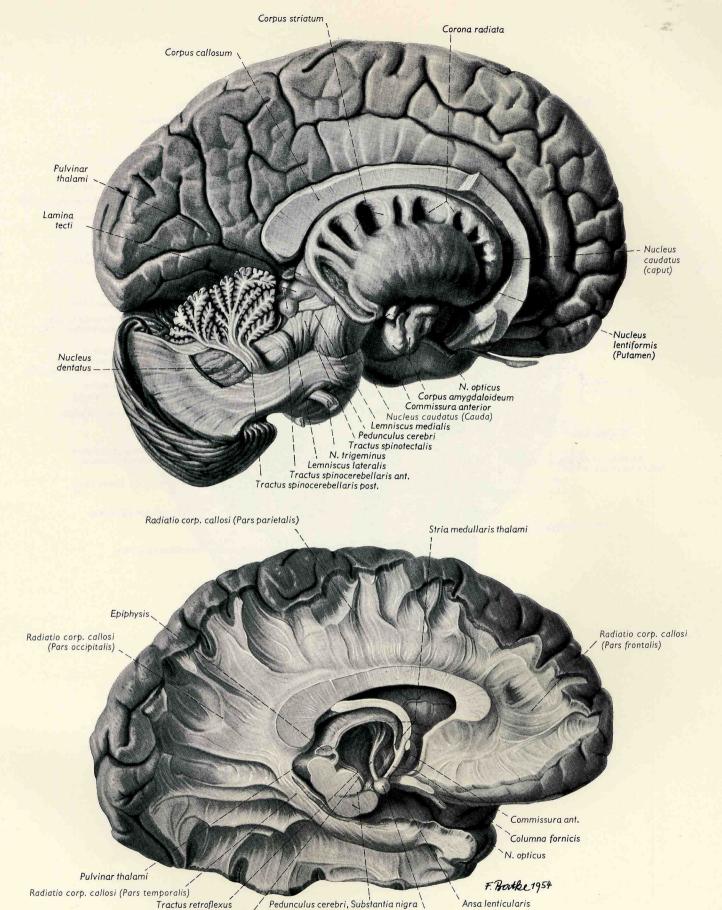


Fig. 114 (Top) Dissection of cerebellar tracts, the medial and lateral lemnisci as well as the caudate nucleus, lentiform nucleus and amygdaloid body.

Corpus mamillare

Tractus mamillothalamicus

Fig. 115. (Bottom) Radiations of corpus callosum to the left hemisphere, medial view. The anterior commissure, columns of the fornix, mamillothalamic tract, retroflexus and ansa lenticularis are also brought into view. In order to expose these structures, portions of the thalamus were removed.

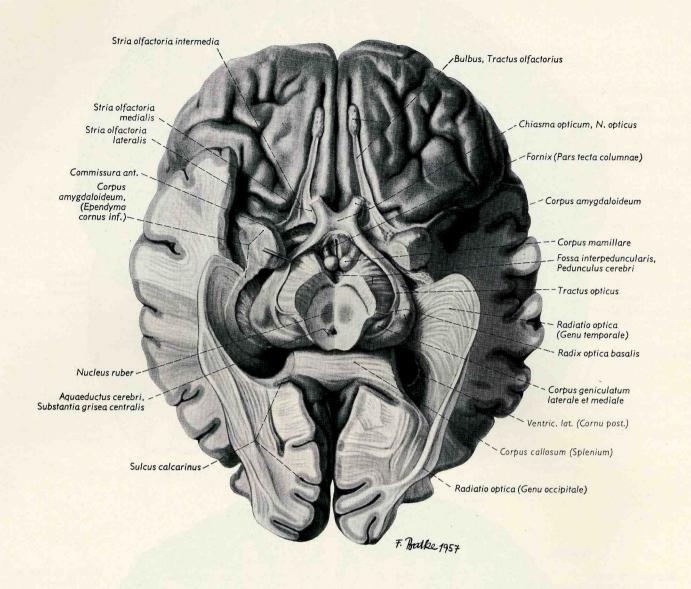


Fig. 116. Dissection of the optic pathway, the optic radiation in particular.

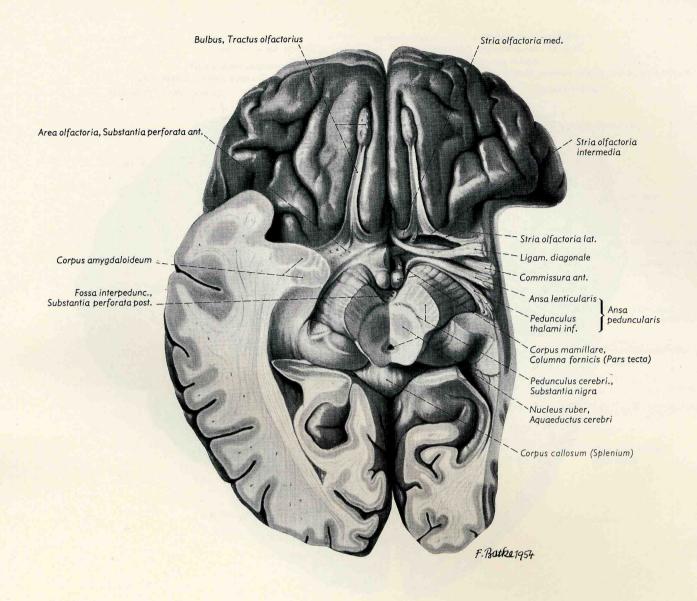


Fig. 117. Dissection of ansa peduncularis and the anterior commissure, seen from below.

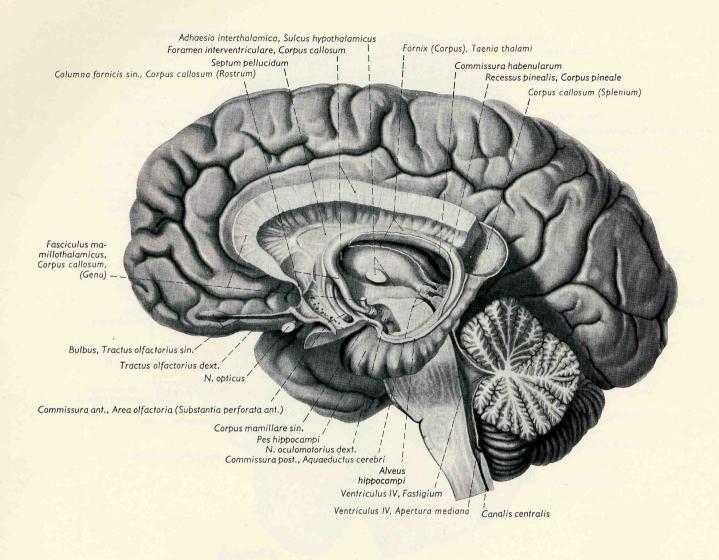


Fig. 118. Lateral view of the left fornix. The hippocampus, the anterior commissure, the olfactory bulb and tract on the left side are also shown. The section through the brain stem was made in the midline; corpus callosum was cut in a left parasagittal plane.

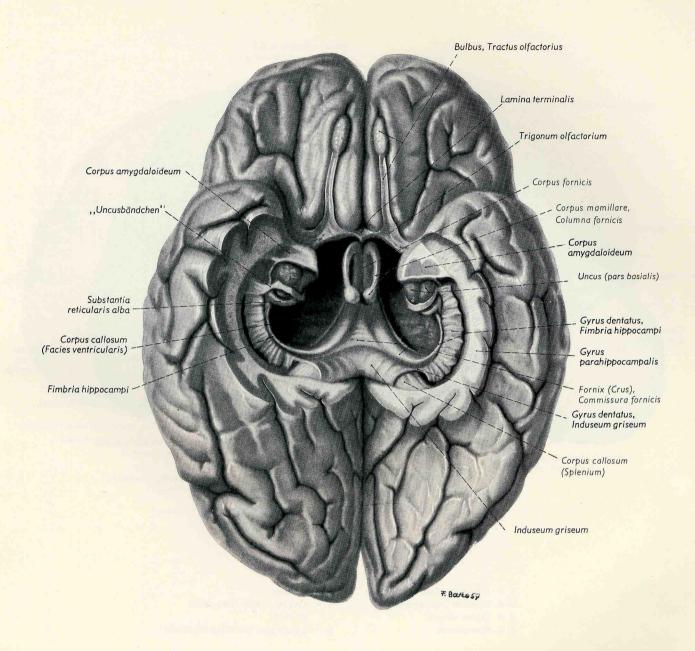


Fig. 119. Inferior view of right and left fornix and dentate gyrus. The parahippocampal gyrus and the basal ganglia have been removed (from a preparation by J. Klingler, Basel).

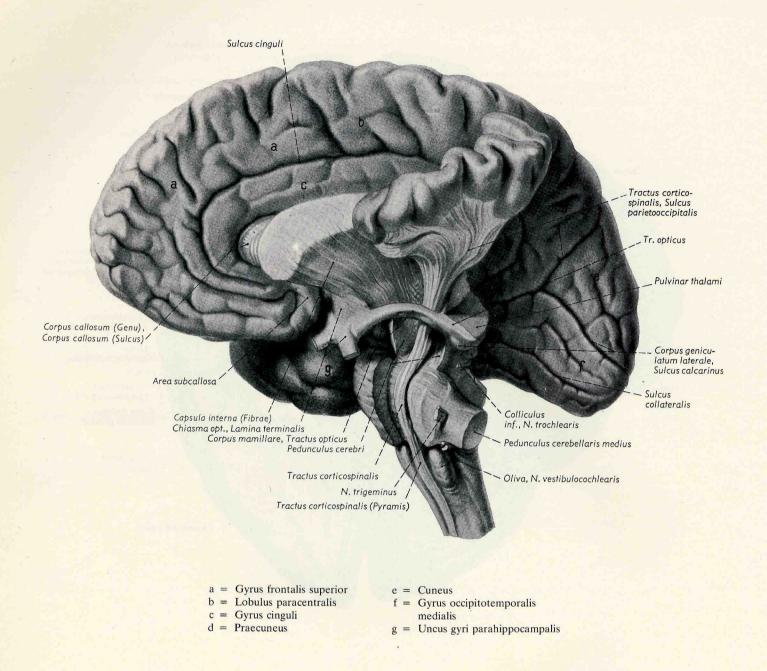


Fig. 120. Dissection of the corticospinal tract. Portions of pons, the cerebral peduncles and the lentiform nucleus were conservatively resected in order to visualize the fibers in the area of the internal capsule. Since the precentral gyrus represents the main area of origin of the pyramidal tract, all other tracts entering or leaving the internal capsule were removed.

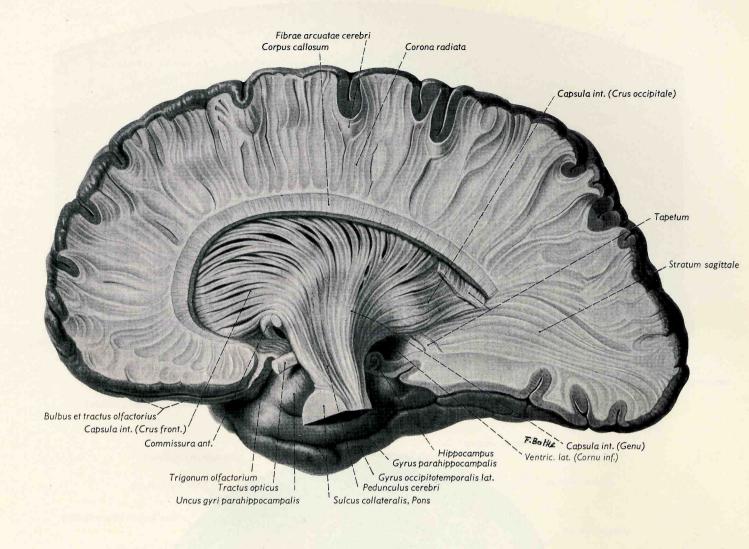
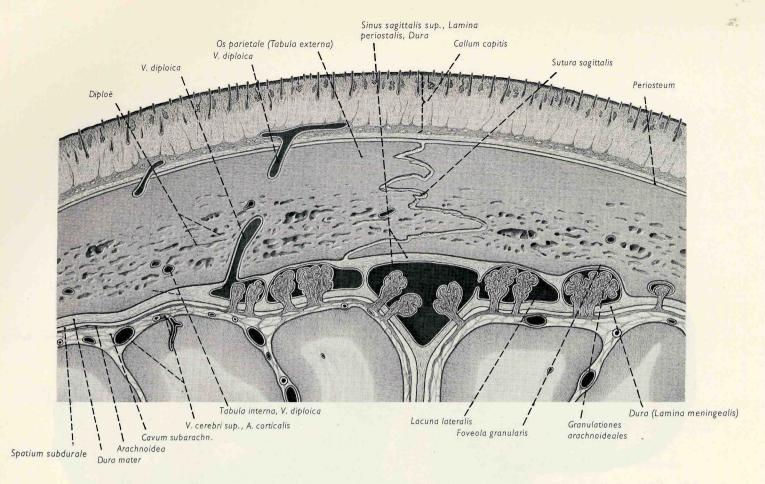


Fig. 121. Fiber preparation of corona radiata, medial view. The internal capsule was exposed by removal of the caudate nucleus and thalamus (from a preparation by J. Klingler, Basel).



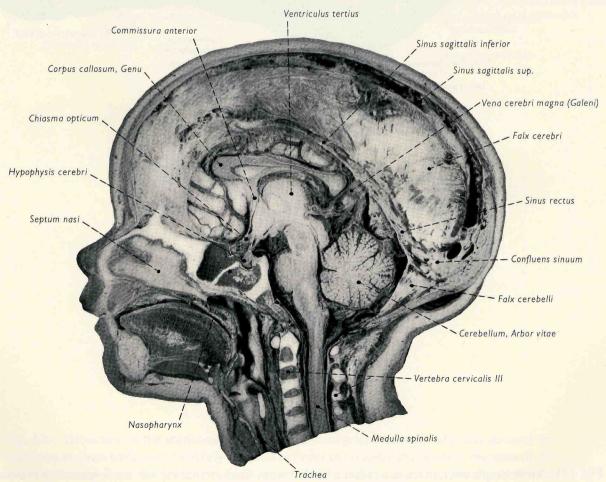
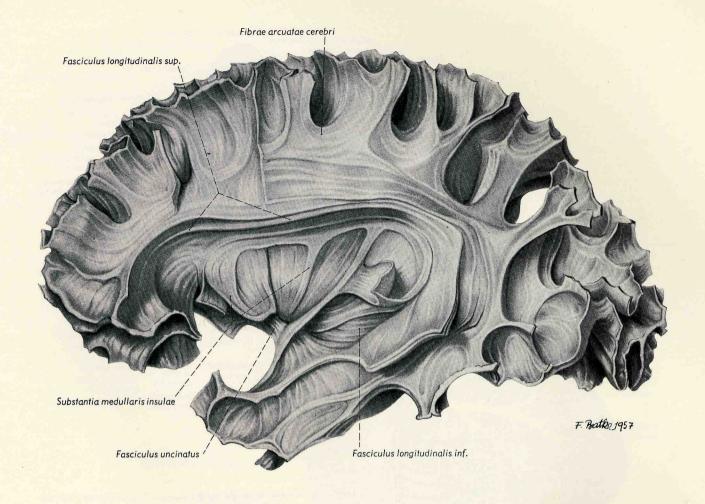


Fig. 122. (Top) Frontal section through the superior sagittal sinus and the lateral lacunae.

Note the arachnoid granulations.

Fig. 123. (Bottom) Head of a child (three week old). Median section.



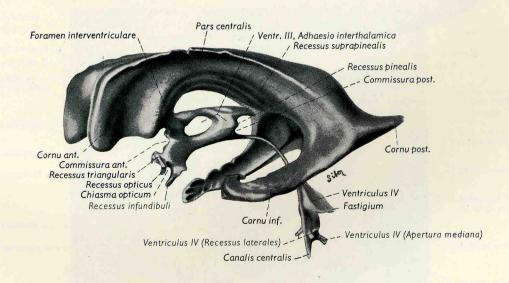
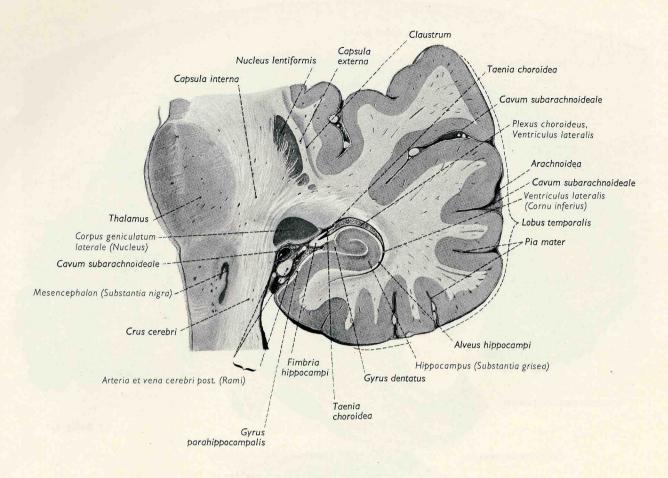


Fig. 124. (Top) Lateral view of the association pathways of the left hemisphere (from a dissection).

Fig. 125. (Bottom) Cast of the ventricular system seen from the left side.

Of the lateral ventricles only the left one is labeled.



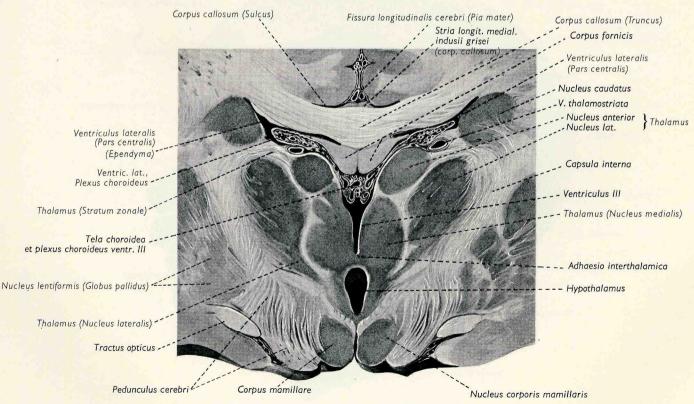


Fig. 126. (Top) Frontal section through the temporal lobe. Boundaries of the inferior horn of the lateral ventricle (from Sobotta/Becher).

Fig. 127. (Bottom) Frontal section through the lateral ventricles, the third ventricle, corpus callosum, fornix and hypothalamus at the level of the mamillary bodies (from Sobotta/Becher).

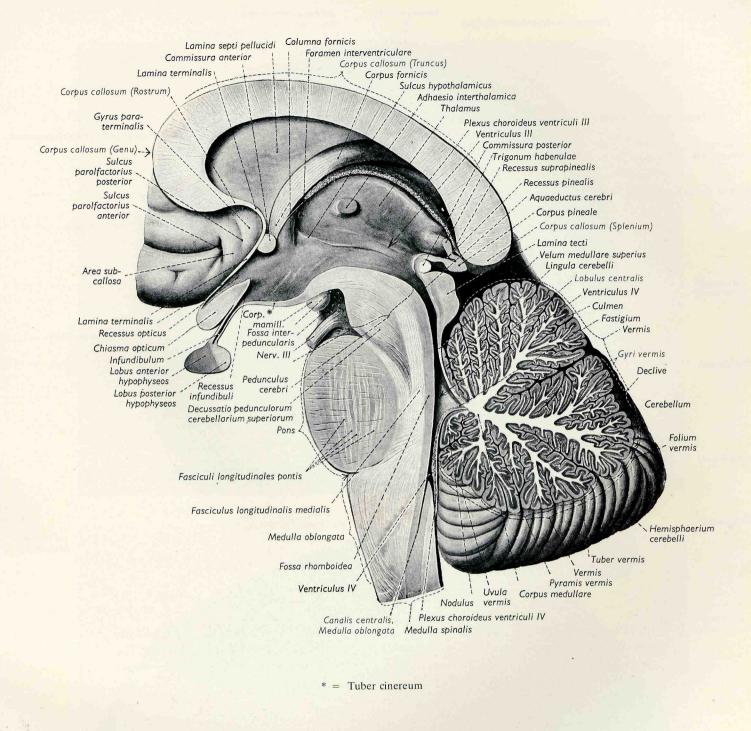


Fig. 128. Median section through the brainstem. Cut surface of the right half. The walls of the third and fourth ventricles as well as the cerebral aquaduct are yellow (from Sobotta/Becher).

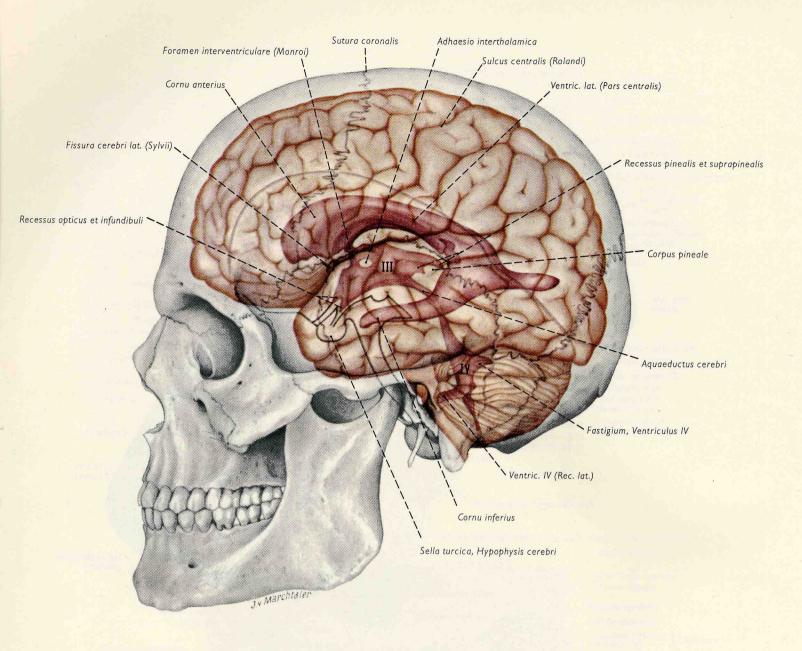


Fig. 129. The ventricular system and its topographical relationships within the brain and the bony skull. Normally the anterior horn does not extend anteriorly beyond the coronal suture. The inferior outline of the brainstem as the median contour of the skull base are identified by simple lines (preparation by Ferner/Kautzky).

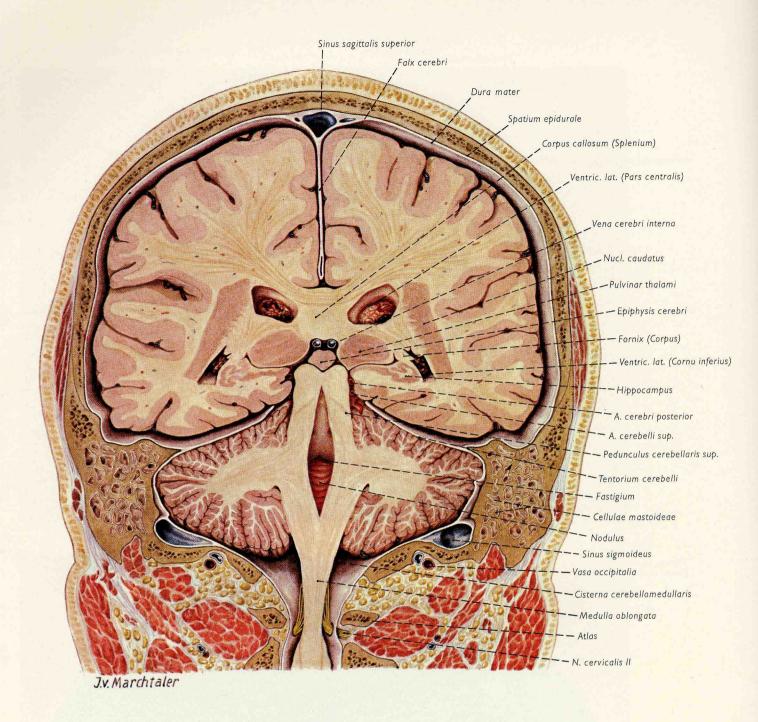
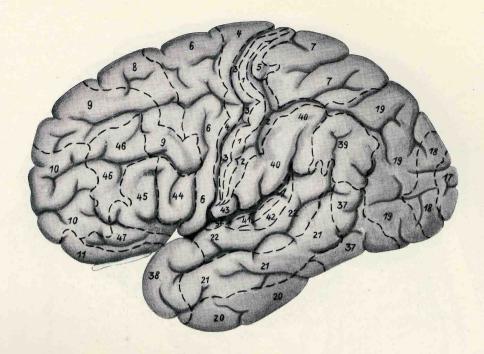
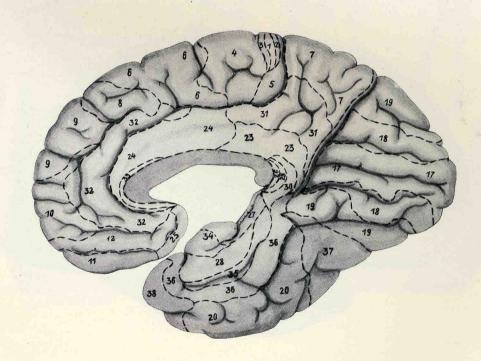


Fig. 132. Frontal section through the brain at the level of the epiphysis and the superior colliculi. Incomplete compartmentalization by the three radiating dural septa. Dorsal view of the section. The hippocampal gyrus with the posterior cerebral a. lie above the free edge of the tentorium.

Point compression (preparation by Ferner/Kautzky).

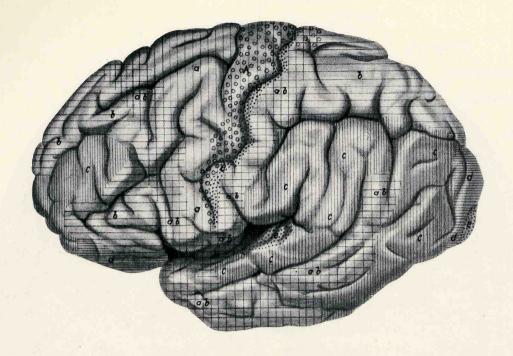


a) Convex surface of the left hemisphere

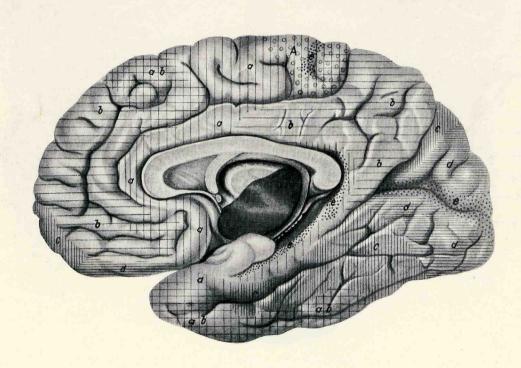


b) Medial surface of the right hemisphere

Fig. 133. Brodmann's cytoarchitectonic cortical areas in man.



a) Convex surface



b) Medial surface

III a = wide cortical layer, agranular,

pyramidal type

% A = wide cortical layer, agranular,
pyramidal type modified by the
presence of giant cells

≡ b = medium cortical layer, granular, pyramidal type

⊞ ab = transitional pyramidal type

c = granular parietal type

■ d = narrow cortical layer, granular type

::: e = granular type (koniocortex)

Fig. 134. Distribution of five cytoarchitectonic cortical areas (from v. Economo/Koskinas).

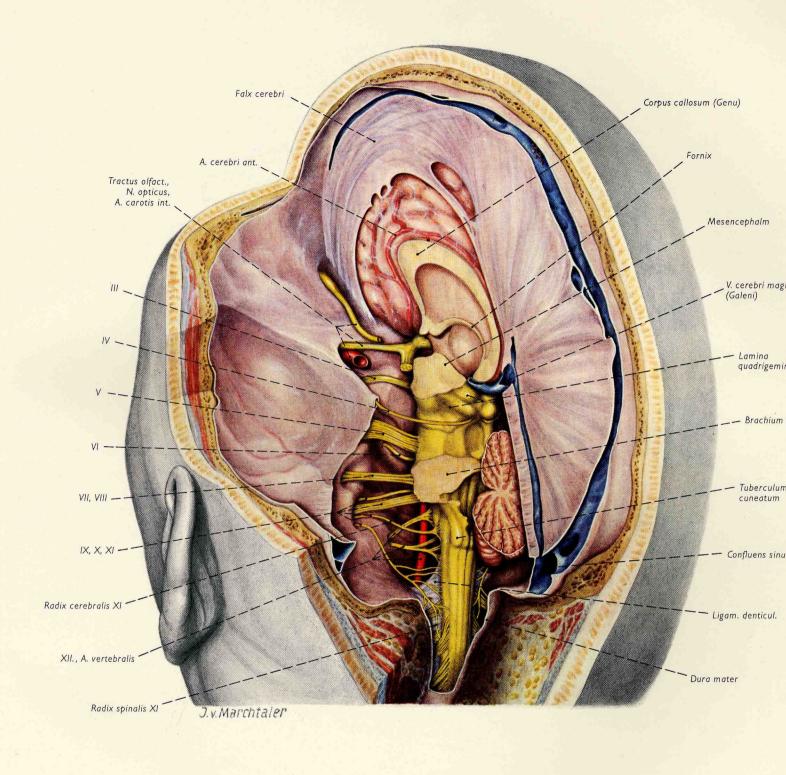


Fig. 135. Brain stem and cranial nerves and their relationship to the base of the skull. The entire leptomeningeal course of the 12 cranial nerves is shown (from Ferner/Kautzky, in: Handbuch der Neurochirurgie, Vol. 1, Berlin–Heidelberg–New York, 1959).

The Face Region

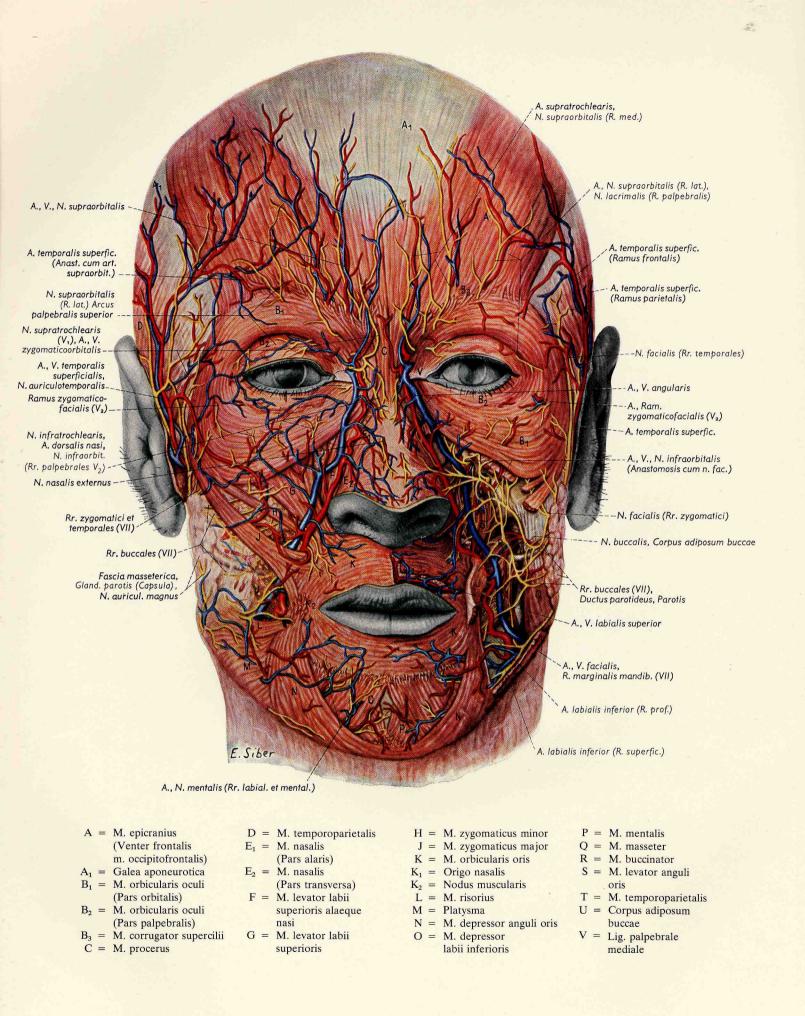


Fig. 136. Mimic musculature, superficial blood vessels, and nerves of the face from front.

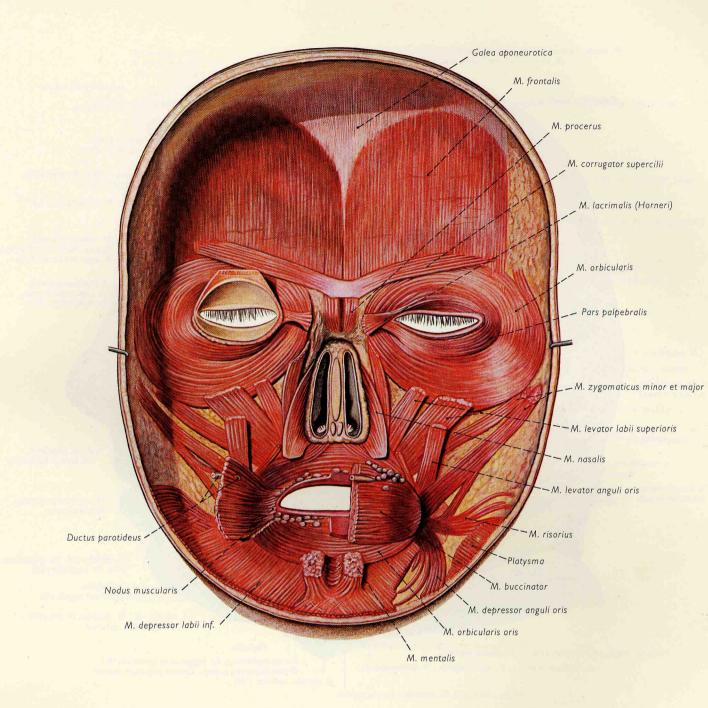


Fig. 137. The mimic musculature removed as a mask and viewed from the skeletal side. The right buccinator muscle has been reflected medially so that its superficial surface may be seen.

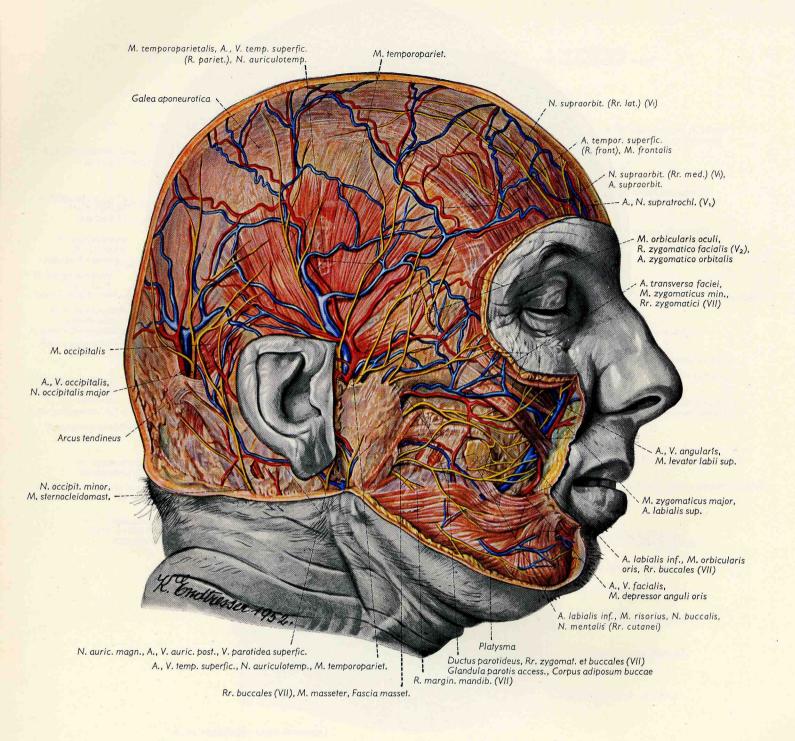


Fig. 138. The superficial blood vessels and nerves of the face and scalp from the side.

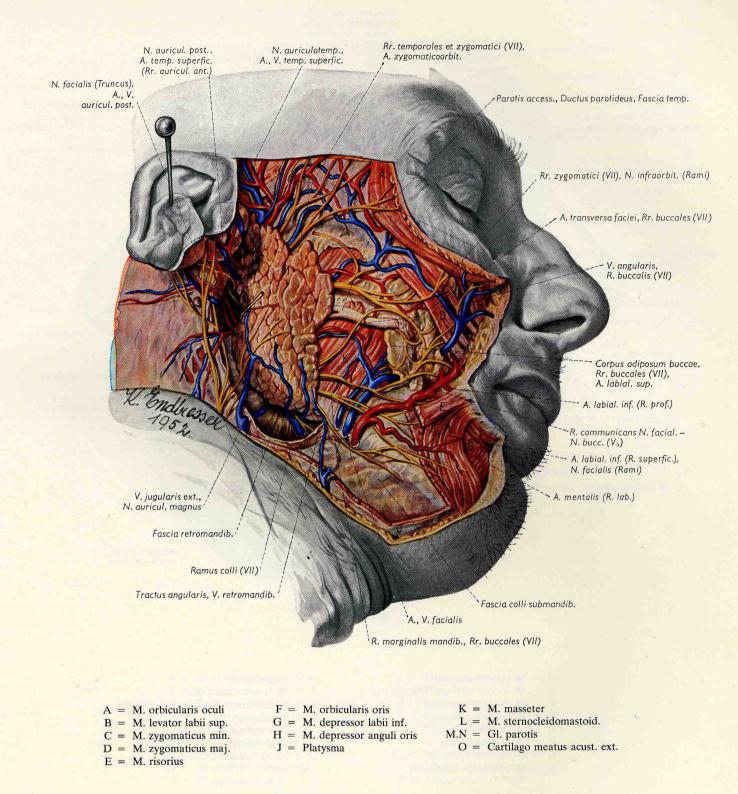


Fig. 139. Blood vessels and nerves in the lateral face region, in the parotid gland and the reteromandibular fossa.

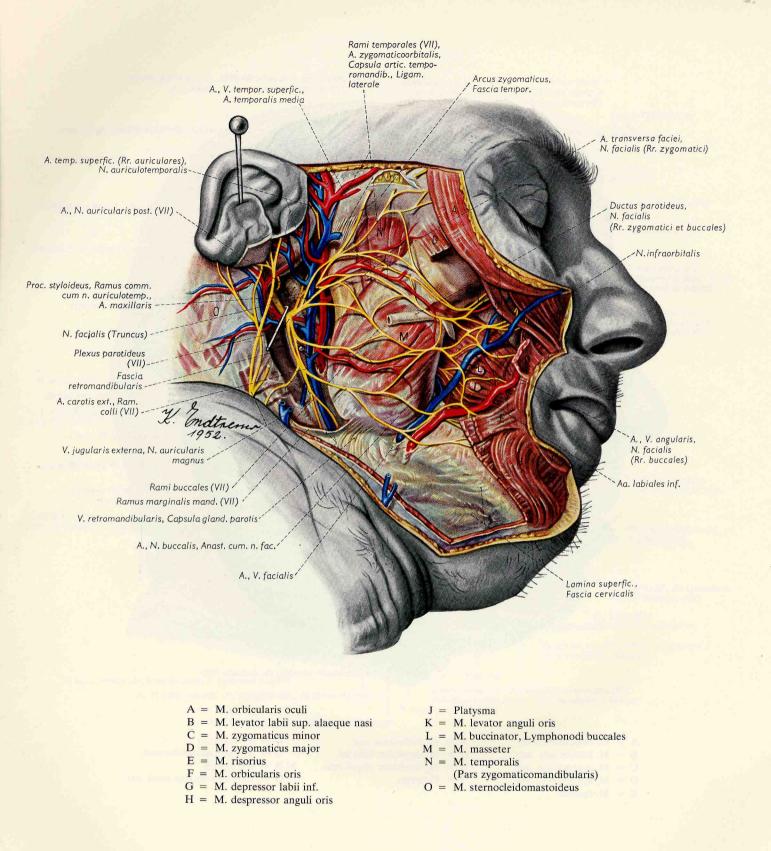


Fig. 140. Superficial vessels, nerves, and muscles of the face; parotid removed. The trunk of the facial nerve has been exposed where it emerges from the stylomastoid foramen. The buccal fat pad is removed.

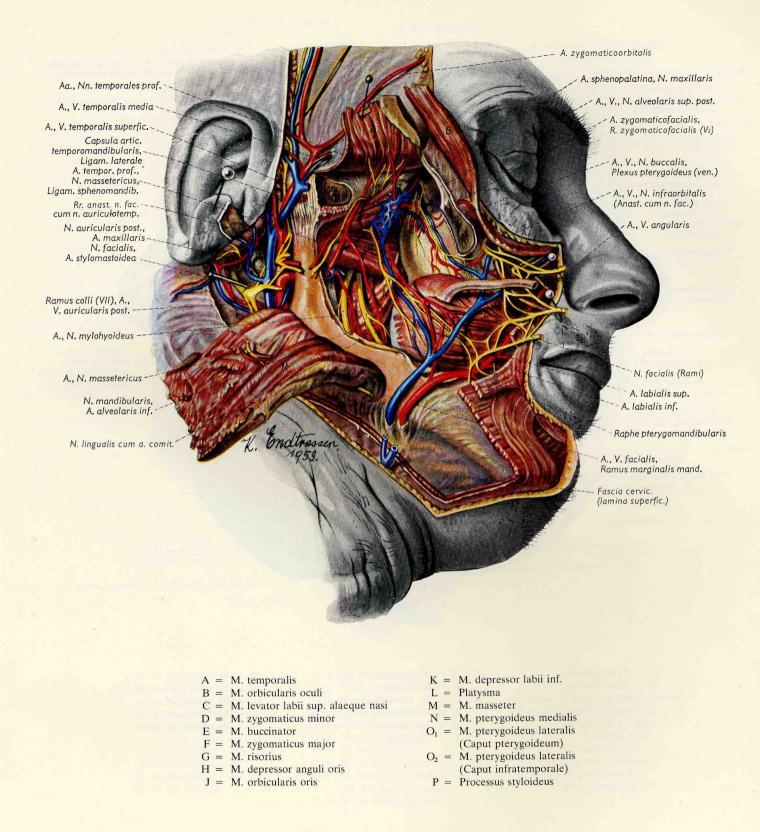


Fig. 141. Vessels, nerves, and muscles of the deep facial region, the retromandibular fossa, and the temporomandibular joint.Branches of the facial nerve and the parotid duct have been cut and reflected forward. The coronoid process and part of the ramus of the mandible have been removed.

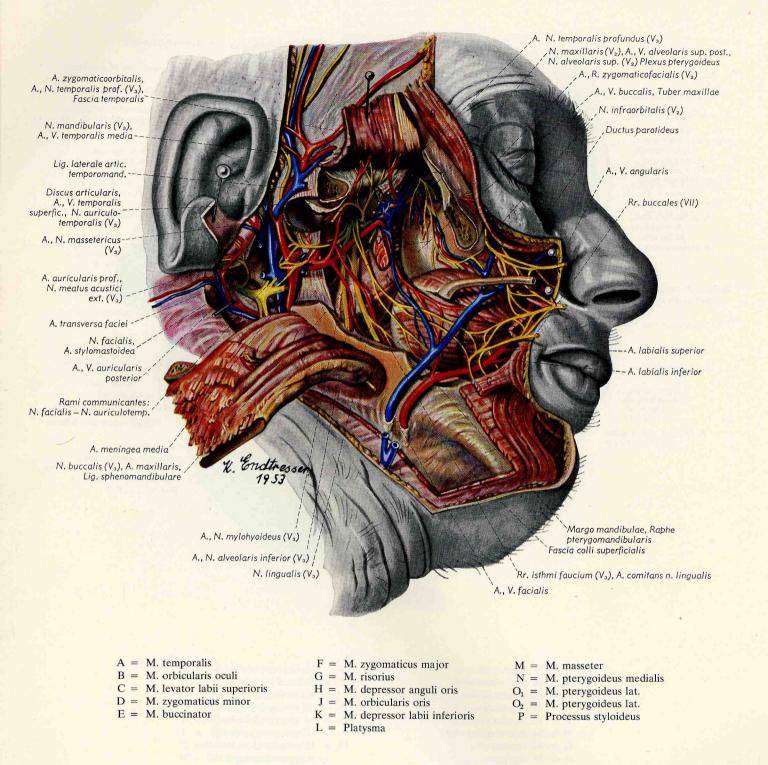


Fig. 142. Blood vessels and nerves in the deep lateral face region (infratemporal and retromandibular fossae).

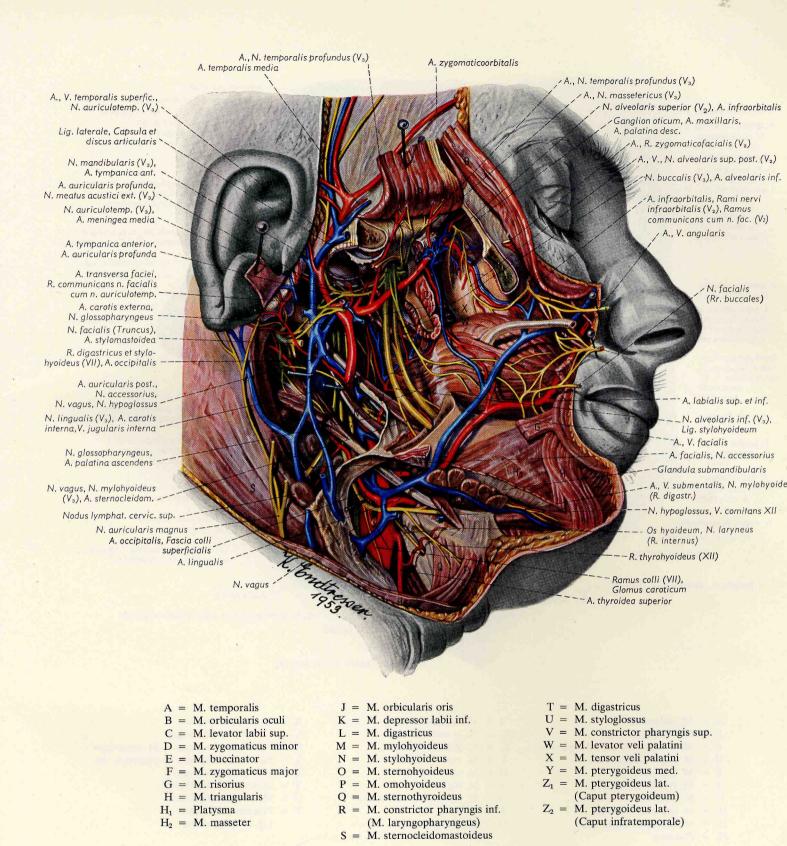


Fig. 143. Deep lateral face region after resection of the ramus of the mandible.

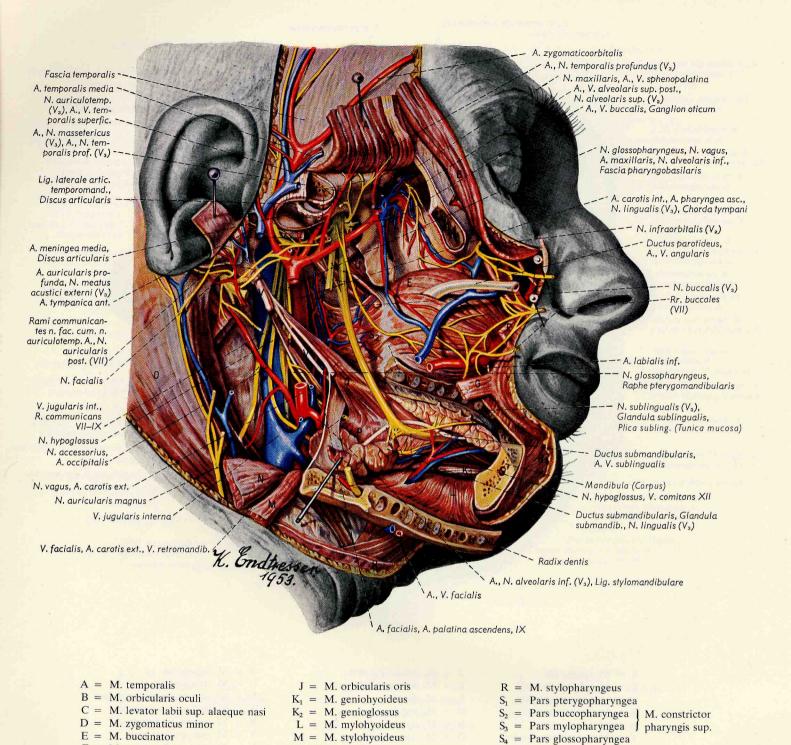


Fig. 144. Blood vessels and nerves in the infratemporal, retromandibular, and submandibular fossae after removal of the right half of the mandible.

T = M. levator veli palatini

U = M. tensor veli palatini

V = Processus styloideus,

Lig. stylohyoideum

N = M. digastricus

P = M. hyoglossus

Q = M. styloglossus

O = M. sternocleidomastoideus

F = M. zygomaticus major

 $H_1 = M$. depressor labii inf.

 $H_2 = M$. depressor anguli oris

G = M. risorius

 H_3 = Platysma

Visceral Compartments of the Head

Nose and Paranasal Sinuses

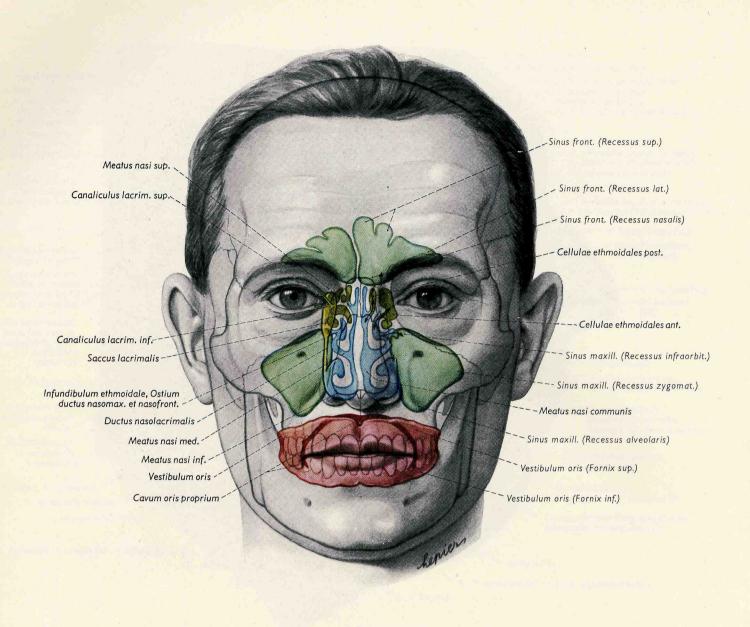


Fig. 145. Sagittal projection of the visceral compartments of the head seen from front. The outlines of the oral and nasal cavities as well as the paranasal sinuses are indicated in different colors.

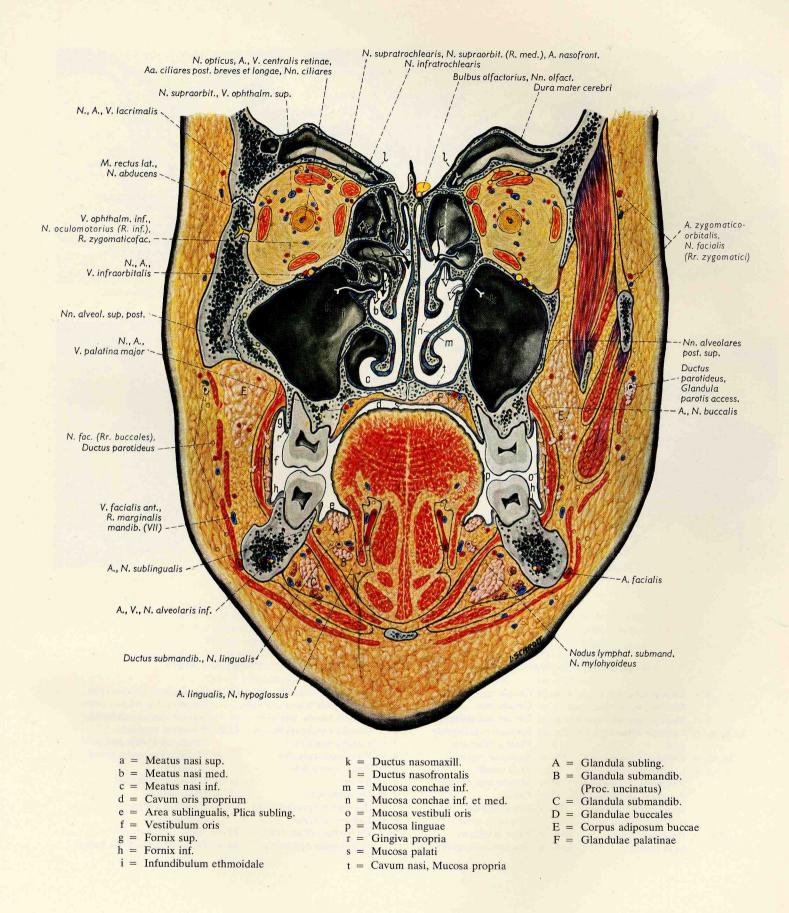
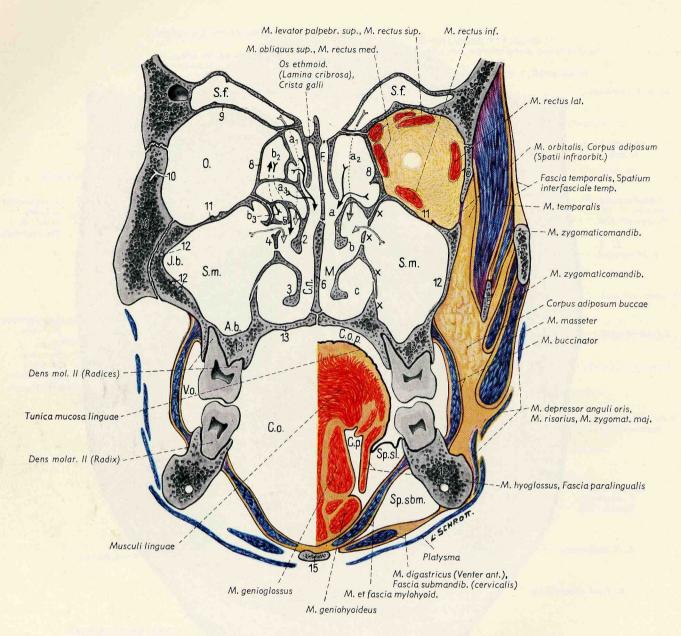


Fig. 146. Retrobulbar frontal section through the facial skeleton. In the mouth and nose regions the cut goes through the second molar. Section viewed from behind.

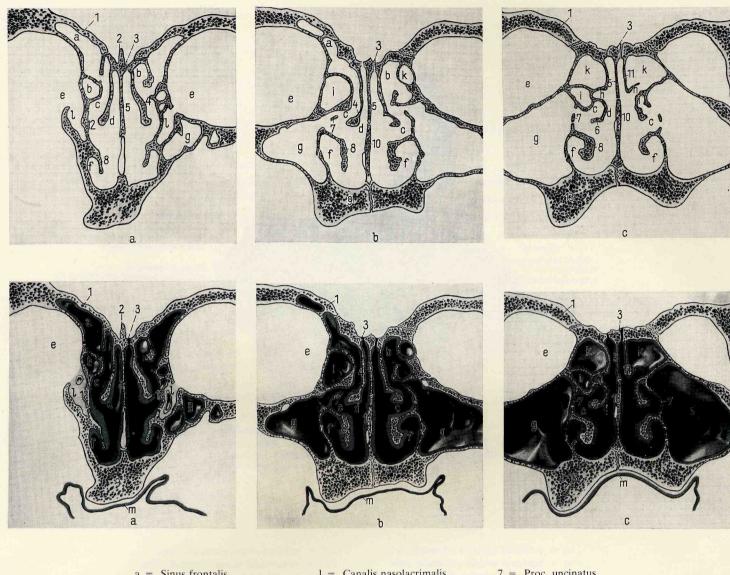


Black arrows = openings of ethmoidal cells; Gray arrows = openings of frontal and maxillary sinuses

	a	=	Meatus nasi sup.	C.n. =	Cavum nasi	Sp.sbm.	=	Spatium submandib.	10 =	Os zygomat. (Facies orbit.)
	b	=	Meatus nasi med.	C.o. =	Cavum oris	V.o.	=	Vestibulum oris		Foramen zygomatico orbit.
	С	=	Meatus nasi inf.	C.o.p. =	Cavum oris proprium	1	=	Concha nasalis sup.	11 :	= Maxilla, Sulcus infraorbit.
a_1, a_2	, a ₃	=	Cellulae ethmoid.	C.p. =	Spatium paralinguale	2	=	Concha nasalis med.	12 :	= Processus zygomat.,
			post.	F =	Fissura olfactoria	3	=	Concha nasalis inf.		Canaliculi alveol. sup. post.
b ₂	b_3	=	Cellulae ethmoid. ant	. J.b. =	Recessus zygomat.	4	=	Processus uncinatus	13 :	Maxilla (Processus alveol.
X	- x	=	Lamina orbitalis,		sinus maxill.	5	=	Bulla ethmoidalis		et palat.)
			Processus uncinatus,	M =	Meatus nasi comm.	6	=	Vomer	14 :	Corpus mandibulae
			Processus maxillaris	O =	Orbita	7	=	Os ethmoidale	15 :	Os hyoideum
			conchae inf., Facies	S.f. =	Sinus frontalis			(Lamina perpendicularis)	16 :	Mandibula (Proc.
			nasalis maxillae		(Recessus orbit.)	8	=	Lamina orbitalis		coronoideus)
A	ı.b.	=	Recessus alveol.	S.m. =	Sinus maxillaris	9	=	Os frontale (Pars orbit.	17 =	= Arcus zygomaticus
			sinus maxill.	Sp.sl. =	Spatium sublinguale			et processus zygomat.)	18 =	Os sphenoidale (Ala major)

Fig. 147. Frontal section of the musculoskeletal apparatus of the nose and mouth regions.

The cut passes through the second molar. Viewed from behind.



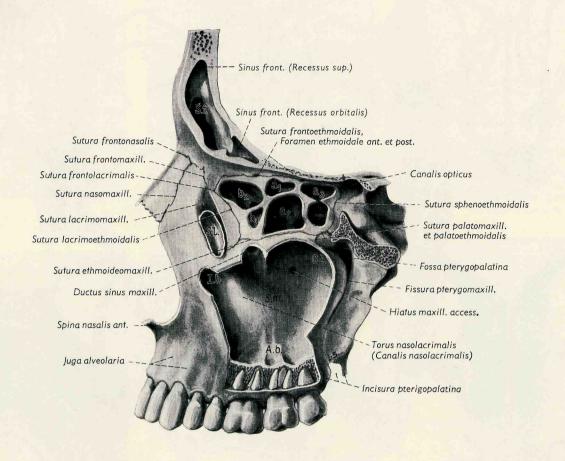
a = Sinus frontalis

- b = Cellulae ethmoid. ant.
- c = Meatus nasi medius
- d = Meatus nasi communis
- e = Orbita
- f = Meatus nasi inferior
- g = Sinus maxilla
- h = Meatus nasi superior
- i = Bulla ethmoidalis
- k = Cellulae ethmoid. post.

- 1 = Canalis nasolacrimalis
- m = Palatum, Tunica mucosa
- 1 = Os frontale
- 2 = Crista galli
- 3 = Lamina cribrosa
- 4 = Os ethmoidale(Lamina conchalis)
- 5 = Lamina mediana
- 6 = Concha nasalis media
- 7 = Proc. uncinatus
- 8 = Concha nasalis inferior
- 9 = Maxilla
- (Processus palatinus)
- 10 = Vomer
- 11 = Concha nasalis
 - superior
- 12 = Os lacrimale 13 = Os palatinum

Fig. 148. Frontal sections through the bony framework of the nasal cavity, the ethmoidal air cells, and the maxillary sinus. Sections a, b, and c were made through the anterior, middle, and posterior thirds of the nasal cavity respectively.

Fig. 149. (Middle) Frontal sections through the nasal cavity, the ethmoidal air cells, and the maxillary sinus showing mucosal relationships.



 $\begin{array}{lll} a_1 &=& posterior \ superior \ ethmoidal \ cells \\ a_2 &=& posterior \ middle \ ethmoidal \ cells \\ a_3 &=& posterior \ inferior \ ethmoidal \ cells \\ b_2 &=& anterior \ middle \ ethmoidal \ cells \\ b_3 &=& anterior \ inferior \ ethmoidal \ cells \\ A.b. &=& alveolar \ recess \ of \ maxill. \ sinus \\ with \ alveolar \ juga \ formed \\ by \ roots \ of \ the \ molars \end{array}$

G.b. = palatine recess of maxill. sinus
I.b. = infraorbital recess of maxill. sinus
S.f. = frontal sinus
S.l. = lacrimal sac (opened)
S.m. = nasal wall of maxill. sinus covered
by mucosa

Fig. 150. Lateral view of the air-filled spaces in the region of the nose (paranasal sinuses).

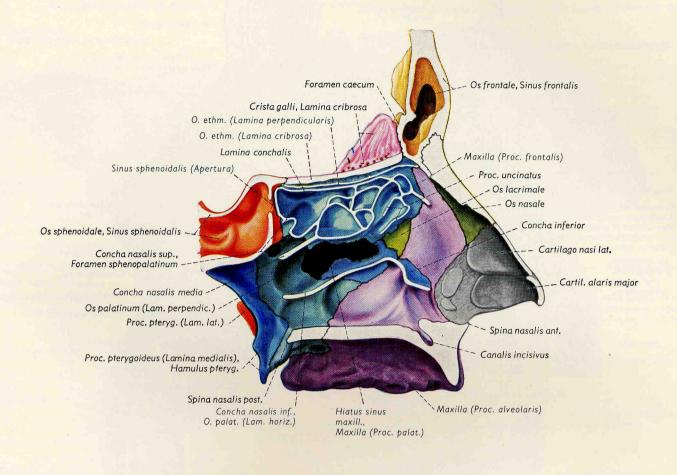


Fig. 151. The bony framework of the lateral nasal wall (bones shown in different colors). The nasal conchae have been removed. The cut edges are white.

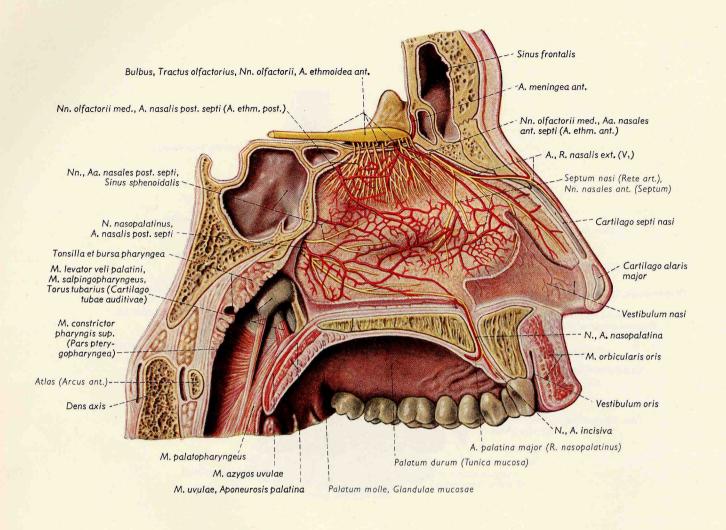
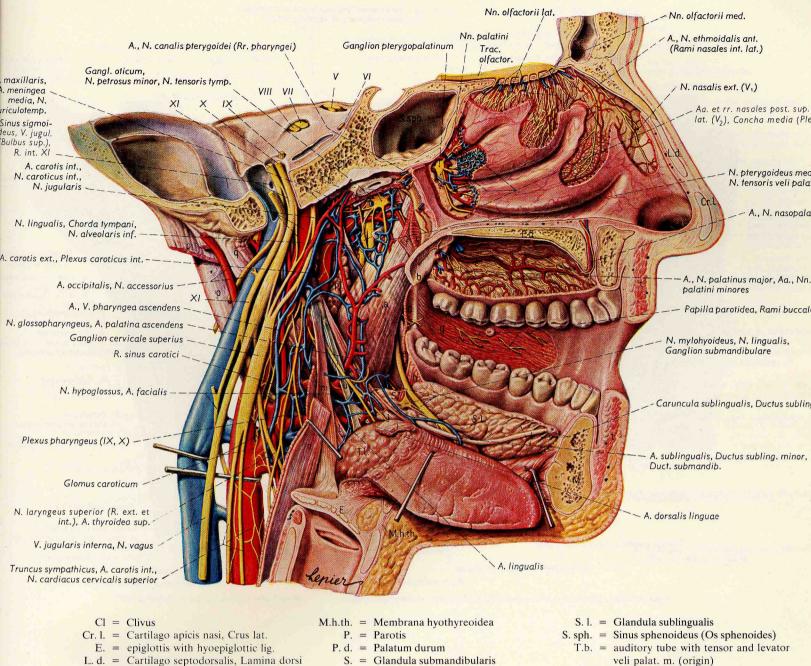


Fig. 152. Arteries and nerves in the region of the nasal septum (mucosa removed).

Musculature of nasopharynx.



L. d. = Cartilago septodorsalis, Lamina dorsi M. = Mandibula a = M. pterygoideus med. b = pterygoid hamulus with tendon of tensor veli palat. m. M. constrictor pharyngis sup. (cut): c = Pars pterygopharyngea d = Pars buccopharyngea

e = Pars pterygopharyngea j = Pars glossopharyngea

I-XII = cranial nerves

S. = Glandula submandibularis veli palat. m. (origin) S. f. = Sinus frontalis (Os frontale) T. l. = Tonsilla lingualis n = M. pharyngopalat. (cut) f = M. tensor veli palat. (cut) g = M. bucinatorius o = M. sternocleidomastoideus p = m. splenius capitis (insertion) h = M. mylohyoideus q = M. biventer (venter mastoid.) i = M. palatoglossus (cut) r = Lig. sphenomandibulare k = M. styloglossus

1 = M. constrictor pharyngis medius s = M. genioglossus t = M. orbicularis oris (cut) m = M. stylopharyngicus u = Lig. stylomandibulare

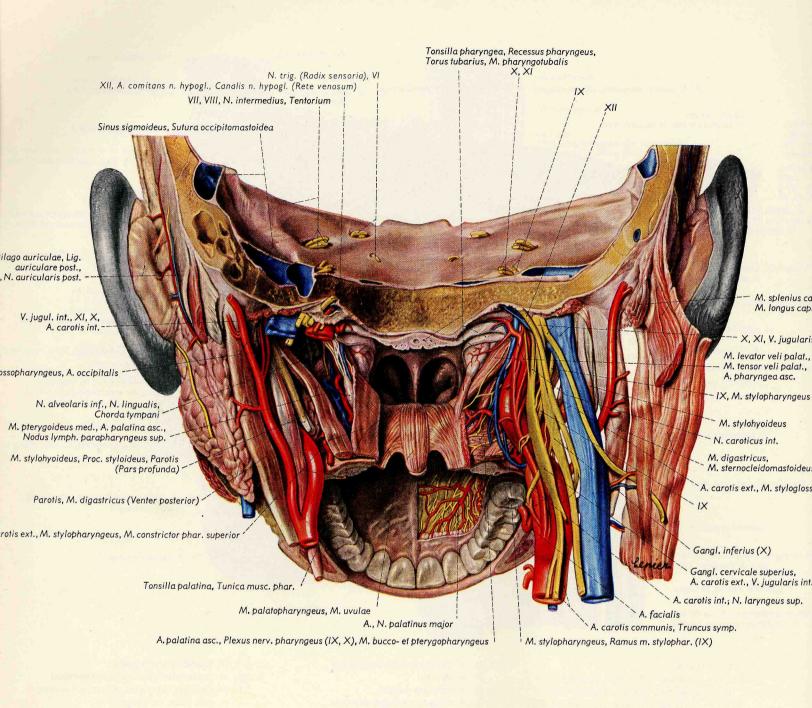


Fig. 154. Parapharyngeal vessels, nerves, and muscles at the base of the skull.

Dorsal view of the choanae and the palate.

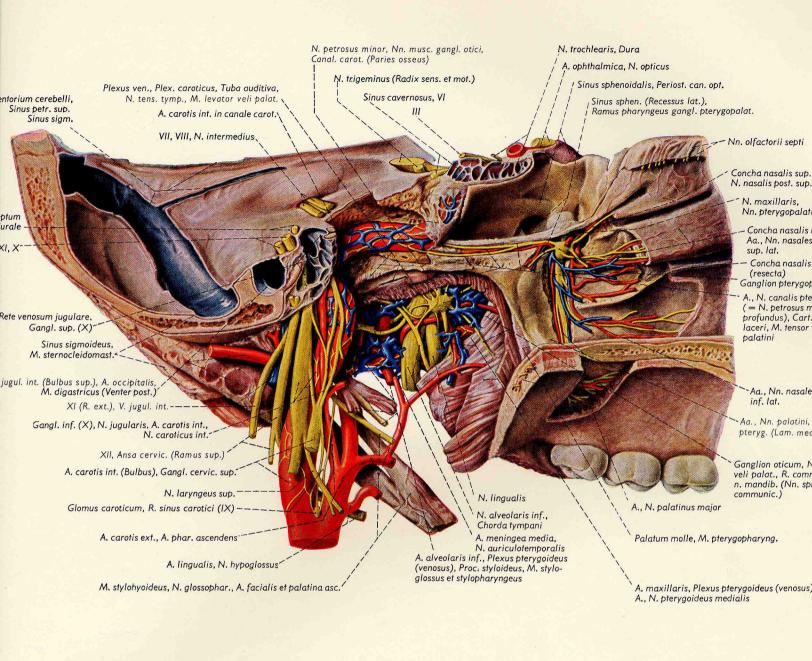


Fig. 155. Blood vessels and nerves in the region of the pterygopalatine fossa, the parapharyngeal spaces, and the lateral wall of the nasal cavity; medial view. The carotid and pterygoid canals have been opened.

Oral Cavity and Teeth

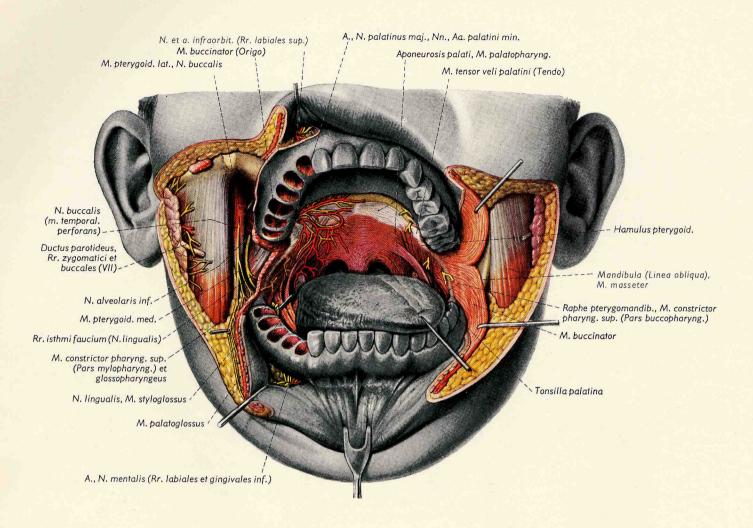


Fig. 156. Vessels and nerves of the oral cavity seen from front. The buccinator muscle has been partly removed on the right side in order to expose the deep muscles of mastication and the nerves of the infratemporal fossa. The lingual nerve on the right side has been elevated from its deep position in the angle between the mylopharyngeal and glossopharyngeal parts of the superior pharyngeal constrictor.

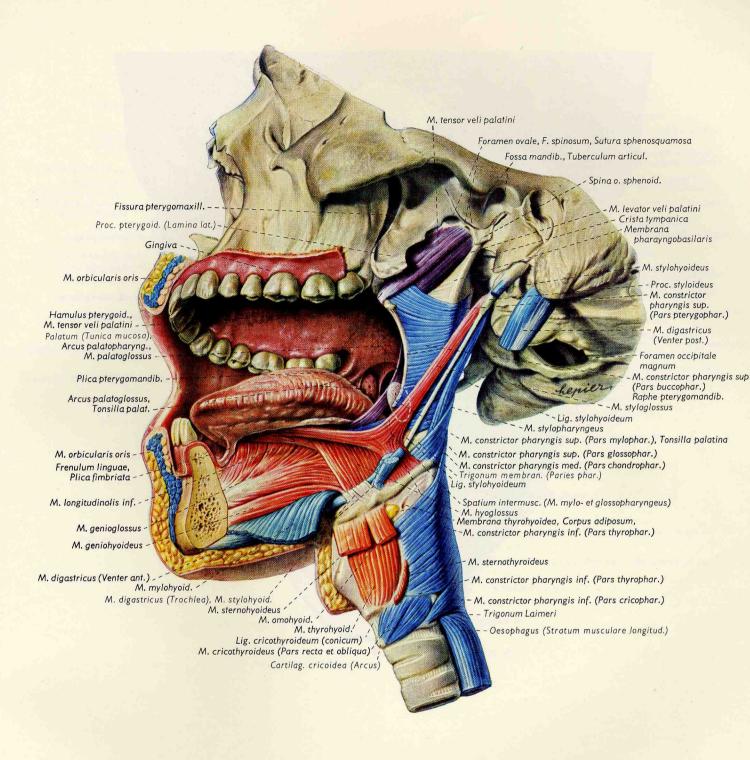


Fig. 157. Musculature of the sublingual region and pharynx; lateral view.

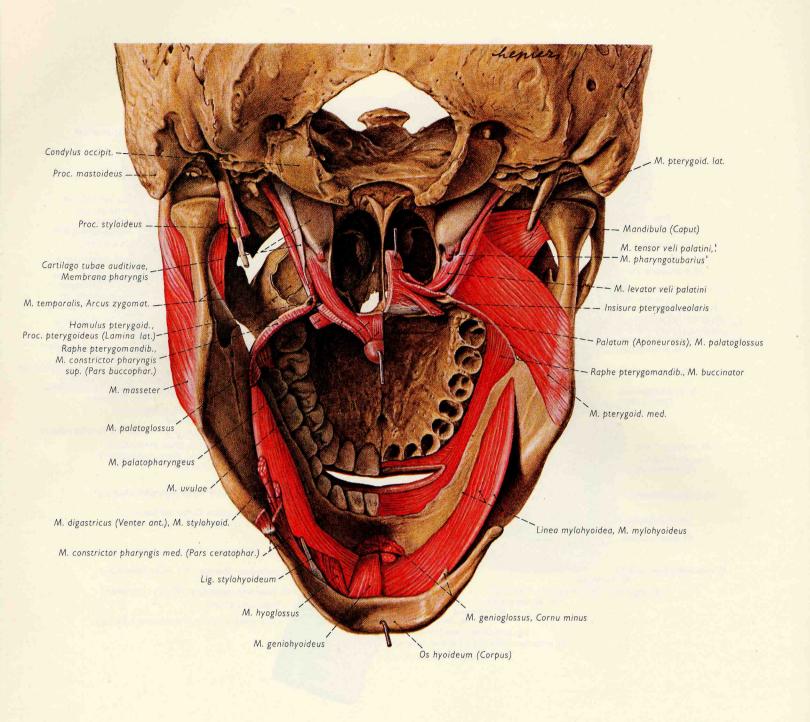


Fig. 158. Musculature and bony framework of the oral cavity seen from behind.

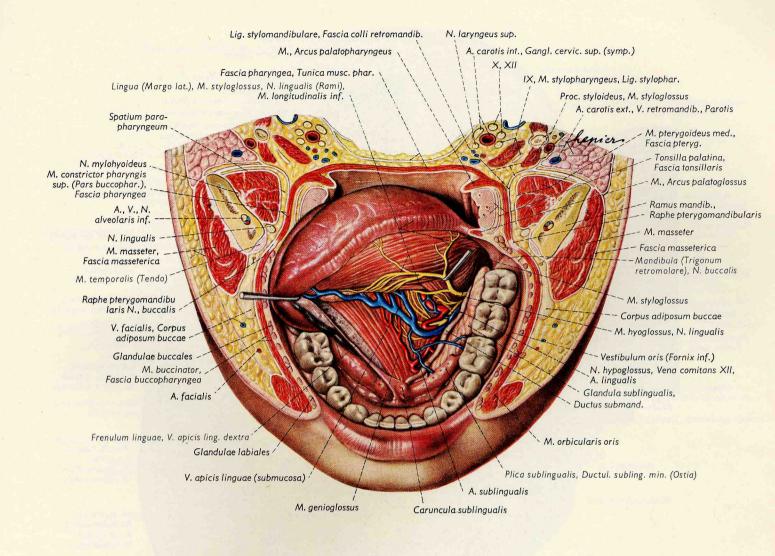


Fig. 159. Vessels and nerves in the floor of the oral cavity and the tongue on the left side. Cross section through the walls of the oral cavity and the pharynx at the level of the occlusal plane.

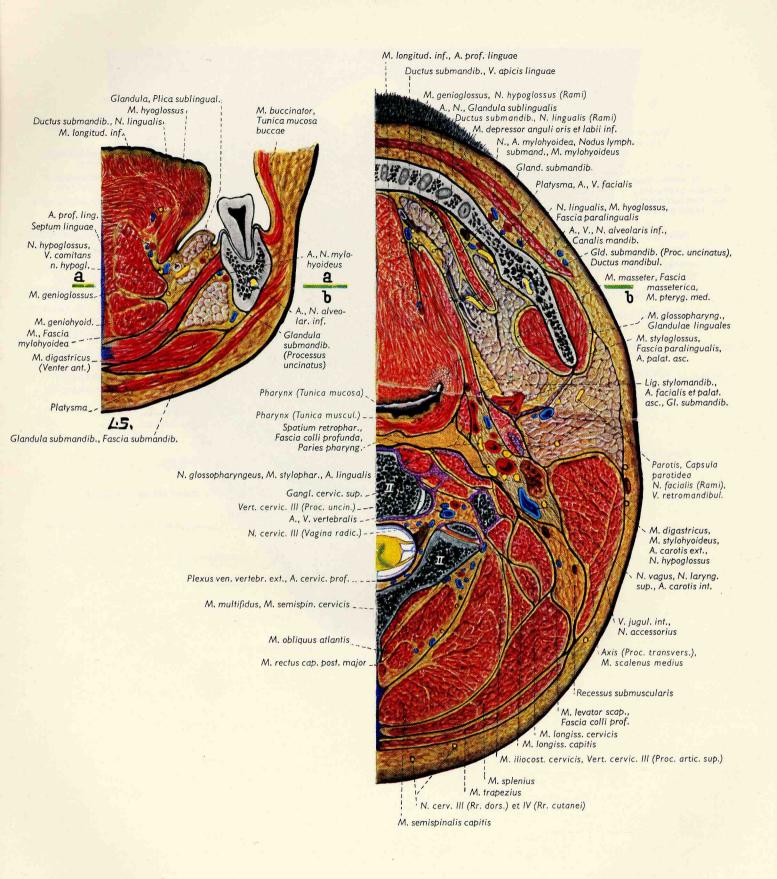


Fig. 160. (Top, left) Frontal section through the lingual, sublingual, and submandibular regions. See Fig. 161 for explanation of the green lines.

Fig. 161. Transverse section through the submandibular and retromandibular regions on the right side. The large salivary glands are shown in cross section. The green lines (a–a, b–b) identify the levels of the frontal section in Fig. 160 and transverse section above.

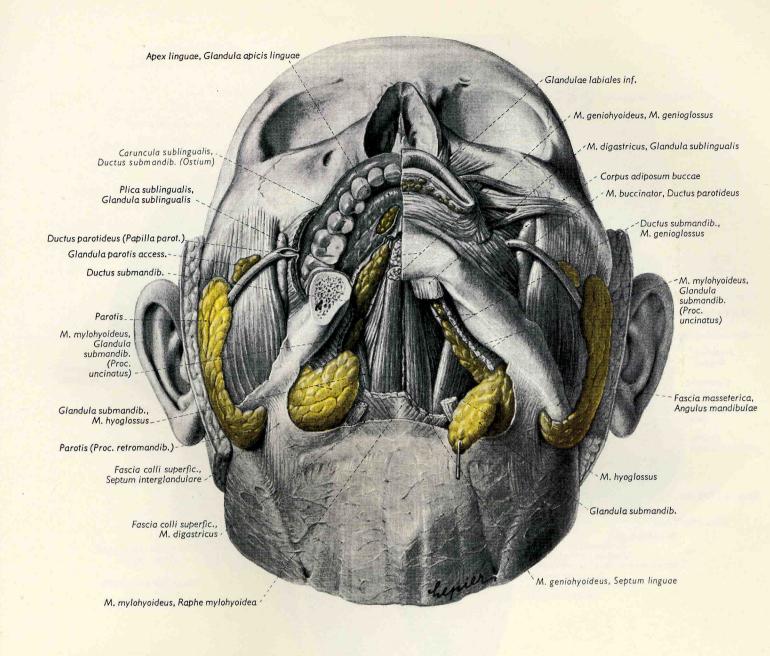


Fig. 162. The large salivary glands seen from front and below. The submandibular fascia and the capsule of the parotid with the masseteric fascia have been removed; the anterior belly of the digastric has been resected; but the "angular tract," an extension of the superficial layer of the cervical fascia, is retained in front of the angle of the mandible.

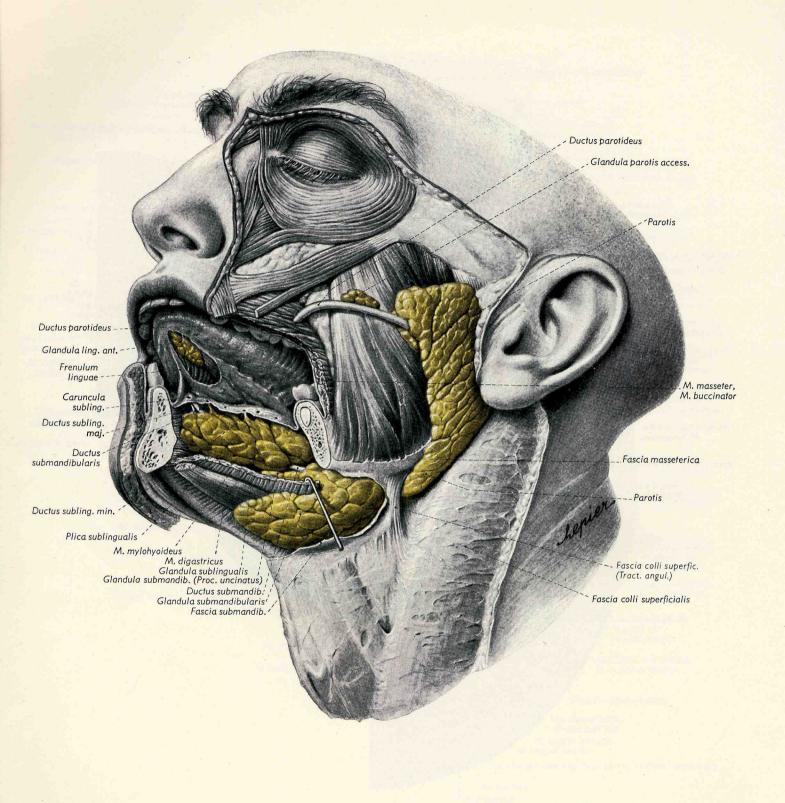


Fig. 163. Lateral view of the large salivary glands and their ducts. The body of the left half of the mandible has been removed.

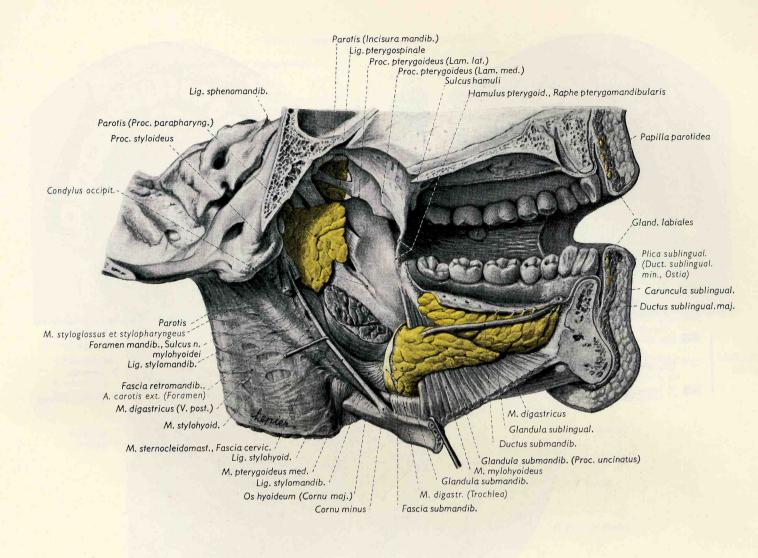
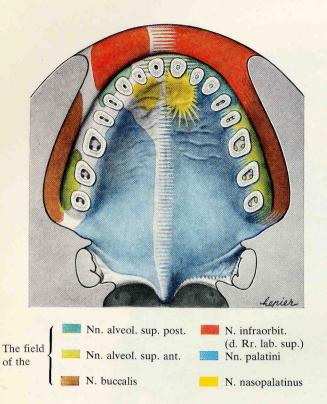


Fig. 164. Medial view of the salivary glands on the left side. The drawing shows the openings of the ducts of the salivary glands, the reationship of the submandibular gland with uncinate process hooking around the posterior border of the mylohyoid muscle, the course and relationship of the submandibular duct to the sublingual gland, and the parapharyngeal process of the parotid which projects forward from the retromandibular fossa between the sphenomandibular and stylomandibular ligaments medial to the medial pterygoid muscle into the parapharyngeal space.



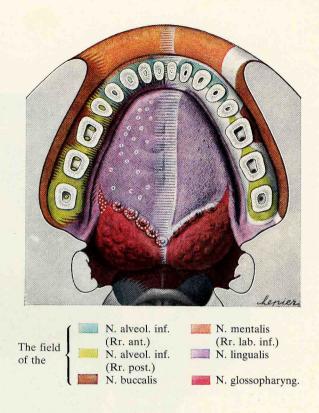


Fig. 165. (Top, left) Sensory fields of mucosal innervation in the roof of the oral cavity (vestibule and oral cavity proper) in the regions of the cheeks, upper lip, gingiva, teeth of upper jaw, and palate. The teeth have been cut transversely through the necks and the pulp cavities are opened so that the relationships of the maxillary dental nerves may be established. Specific areas of innervation by individual nerves are shown on the right side, and maximal areas of distribution and the overlapping fields of innervation are illustrated on the left side in different colors (modified from Scharlau, Ergebnisse der Zahnheilkunde, 1929).

Fig. 166. (Top, right) Sensory fields of mucosal innervation in the floor of the oral cavity (vestibule and oral cavity proper) in the regions of the cheeks, lower lip, gingiva, teeth of lower jaw, and tongue. The teeth have been cut transversely through the necks and the pulp cavities are opened so that the relationships of the mandibular dental nerves may also be established. Specific areas of innervation by individual nerves are shown on the right side, and maximal areas of distribution and the overlapping fields of innervation are illustrated on the left side in different colors (modified from Scharlau, Ergebnisse der Zahnheilkunde, 1929). On the left side, the sensory taste areas innervated by n. intermedius (chorda tympani) are indicated by white rings; sensory taste areas innervated by the glossopharyngeal nerve are identified by white dots.

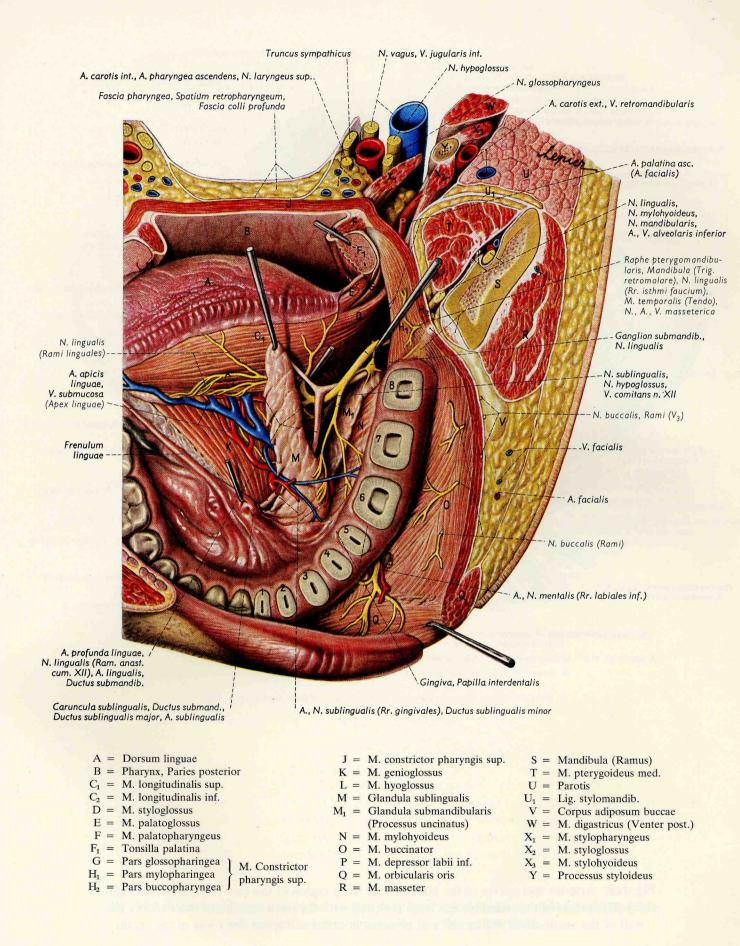


Fig. 167. Cross section through the face at the level of the occlusal plane. The tongue is deviated to the right; the sublingual gland has been mobilized from its bed and elevated.

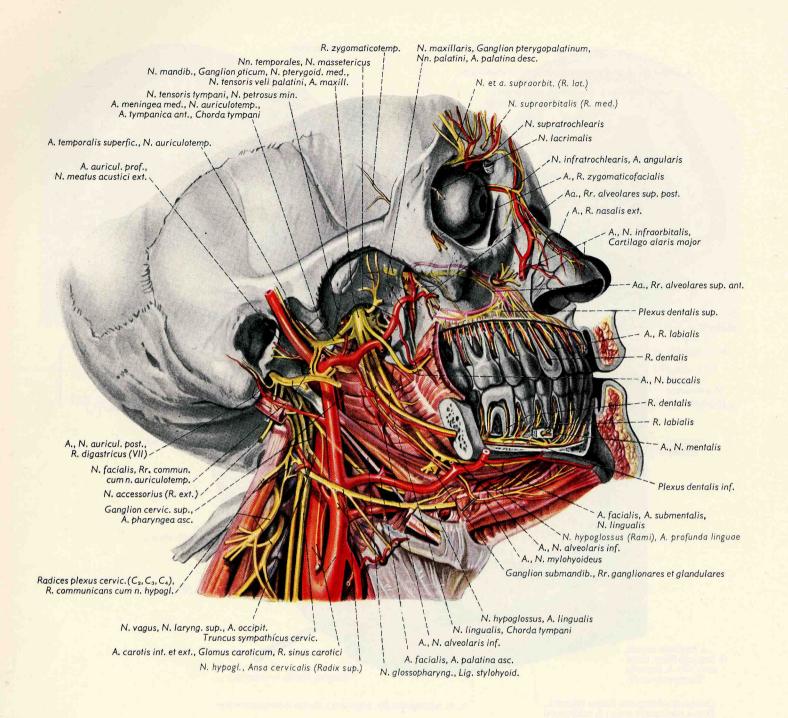
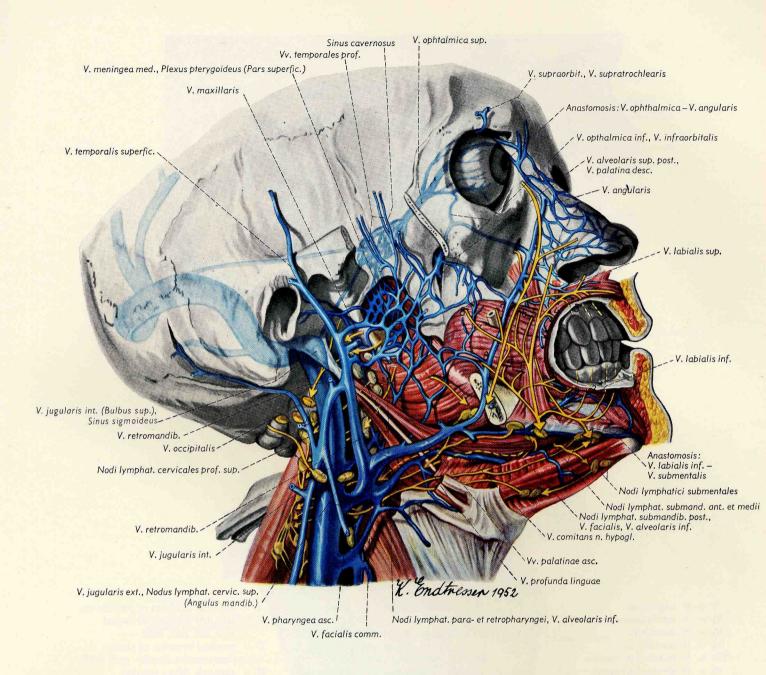
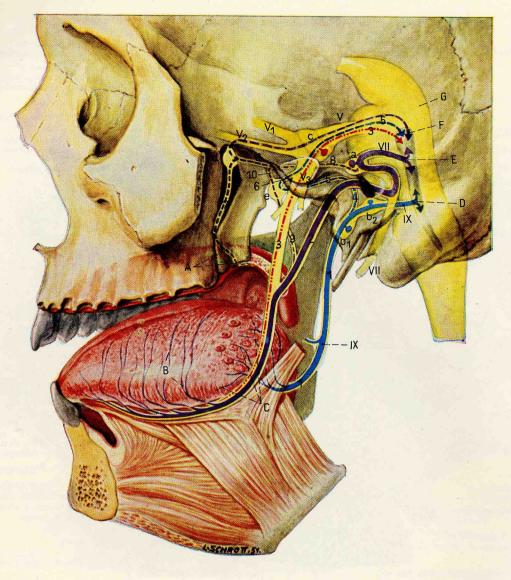


Fig. 168. Arteries and nerves of the jaws and the deep region of the face (seen from the right side). The ramus of the mandible has been removed with the deep muscles of mastication; the wall of the vestibule of the mouth was resected in order to expose the roots of the teeth.



1-8 = Lymph vessels from the teeth (alveoli) of upper and lower jaws

Fig. 169. Veins and lymphatics of the jaw and deep face region seen from right side. Lymph vessels are indicated schematically by plain yellow lines.



V = N. trigeminus

 $V_1 = N$. ophthalmicus

 $V_2 = N.$ maxillaris

 $V_3 = N$. mandibularis

VII = N. facialis-intermedius

IX = N. glossopharyngeus

1 = taste fibers in glossopharyngeal n. 2 = taste fibers in chorda tympani

of facial n.

3 = taste fibers in lingual n. of trigeminal n.

4 = N. tympanicus

5 = N. petrosus minor

6 = root of otic ganglion from mandibular n.

7 = Nn. palatini

8 = N. petrosus major

9 = R. anastomoticus chordae tympani with ganglion oticum

10 = N. sphenoideus med. (int.)

a = geniculate ganglion of facial n.

b₁ = inferior (petrosal) ganglion of glossopharyngeal n.

b₂ = superior ganglion of glossopharyngeal n.

c = semilunar ganglion of trigeminal n.

d = Ganglion pterygopalatinum

e = Ganglion oticum

A = terminal branches of palatine nn.

B = terminal branches of lingual n. in ant. gust. field

C = terminal branches of glossopharyngeal n. in post. gust. field

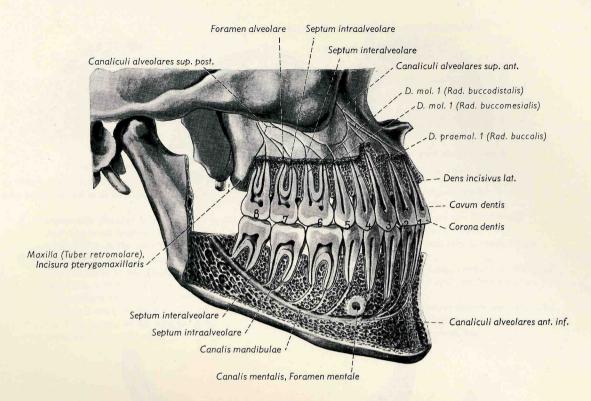
D = glossoph. fibers entering solitary tract and nucl. (gust. nucl.)

E = intermed. fibers entering solitary tract and nucl. (gust. nucl.)

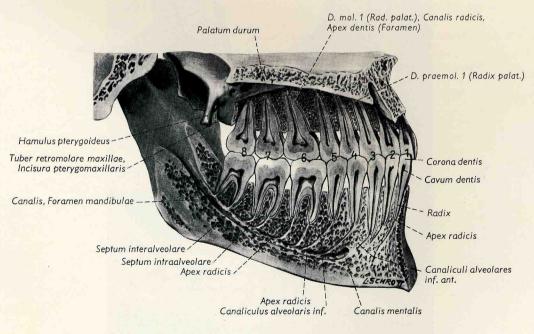
F = trigeminal fibers entering solitary tract and nucl. (gust. nucl.)

G = brain stem

Fig. 170. The course of peripheral taste fibers within the branchial nerves (schematic representation of main and collateral pathways).

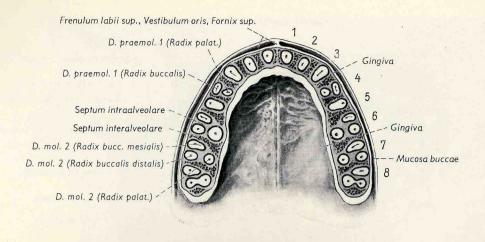


a) Illustration of the upper and lower sets of teeth (1-8), seen from the lateral (vestibular) side.

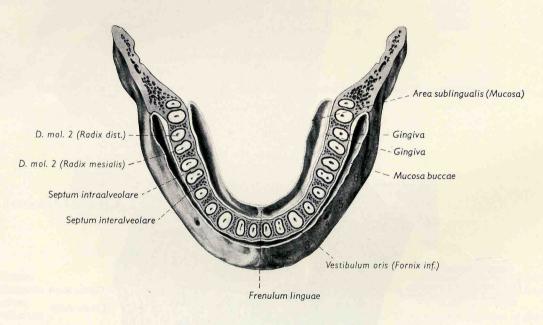


b) Illustration of the upper and lower sets of teeth (1–8), seen from the medial (oral) side.

Fig. 171. One half of the permanent set of teeth with exposure of the entire root structure (by chiseling off the corresponding parts of the alveolar processes in a macerated specimen). The individual tooth is sectioned in its long axis (axial); pulp cavity and root canal have been opened.



a) Roots of permanent teeth in upper jaw (1-8).



b) Roots of permanent teeth in lower jaw.

1 = central incisor

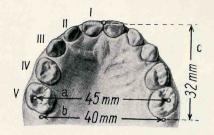
5 = 2nd premolar

2 = lateral incisor

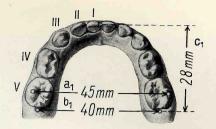
6 = 1st molar

3 = canine tooth 4 = 1st premolar 7 = 2nd molar

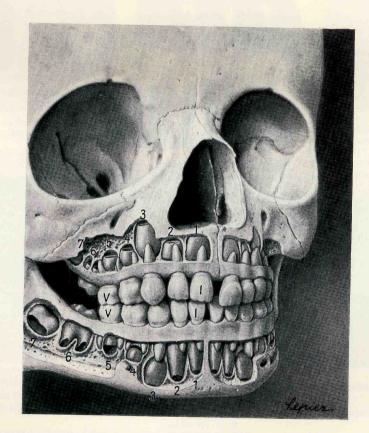
8 = 3rd molar



- a) The row of teeth in the upper jaw of a child (the upper dental arch of deciduous teeth)
 - a = Intermolar distance between the 2 upper
 2nd deciduous molars (45 mm),
 measured from the centers of the crown surfaces
 - b = Intertuberal distance measured behind the distal surfaces of the 2nd upper deciduous molars (40 mm)
 - c = Longitudinal axis of upper dental arch measured from the medial edge of the medial (central) incisor to the middle of the intertuberal line (32 mm)



- b) The row of teeth in the lower jaw of a child (the lower dental arch of deciduous teeth)
 - a₁ = Intermolar distance between the 2 lower
 2nd deciduous molars (45 mm),
 measured from the buccodistal cusps of the
 crown surfaces
 - b₁ = Intertrigonal distance measured behind the distal surfaces of the lower 2nd deciduous molars (40 mm)
 - c₁ = Longitudinal axis of lower dental arch measured from the medial edge of the central incisor middle of the intertrigonal line



I-V = Deciduous teeth of the maxilla and mandible 1-7 = Permanent teeth (anlagen)

Fig. 173. (Top) Deciduous teeth of a 4-5 year old child before eruption of the 1st permanent molar.

Fig. 174. (Bottom) Deciduous teeth and early permanent teeth in a 6 year old child. The roots of the deciduous teeth as well as those of the developing permanent teeth (anlagen) have been exposed in both upper and lower jaws.

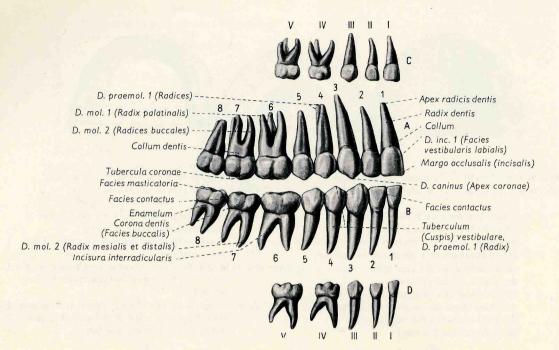
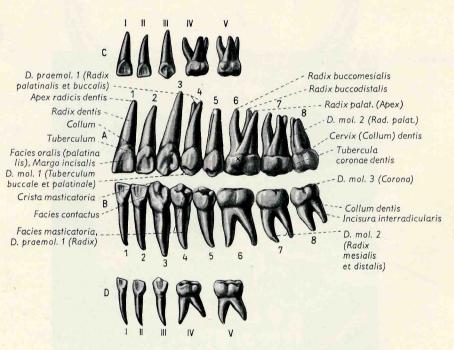


Fig. 176



A = The row of permanent teeth of the upper jaw

B = The row of permanent teeth of the lower jaw

C = The row of deciduous teeth of the upper jaw

D = The row of deciduous teeth of the lower jaw Permanent teeth:

1 = Medial incisor

2 = Lateral incisor

3 = Canine

4 = 1st premolar

5 = 2nd premolar

6 = 1st molar

7 = 2nd molar

8 = 3rd molar

x = Carabelli tubercle

Deciduous teeth:

I = Medial incisor

II = Lateral incisor

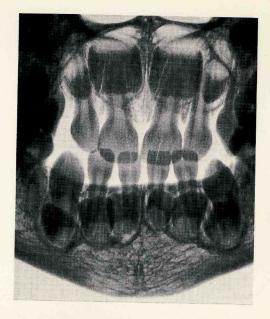
III = Canine

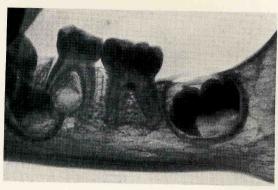
IV = 1st premolar

V = 2nd premolar

Fig. 175. Deciduous and permanent teeth of the right side (seen from the vestibular side).

Fig. 176. Deciduous and permanent teeth of the right side (seen from the oral side).



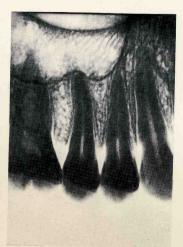




The four incisors



The two incisors and the canine tooth of right side



The canine tooth and the two premolars of right side



The two premolars and the three molars of right side



The four incisors



Lower incisors, canine tooth, and premolars



Premolars, first and second molars



The three molars

- Fig. 177. (Top, left) Roentgenogram of the incisors and canines of the upper and lower jaws in a 2½ year old child. The developing permanent teeth may be seen in the jaw (from W. Meyer, in: Die Zahn-, Mund- und Kieferheilkunde, Vol. II, Munich–Berlin, 1955).
- Fig. 178. (Top, right) Roentgenograms of the deciduous molars and the developing 1st permanent molar in a 2½ year old child (from W. Meyer, in: Die Zahn-, Mund- und Kieferheilkunde, Vol. II, Munich–Berlin, 1955).
- Fig. 179. (Middle) Roentgenograms of permanent teeth. Teeth of upper jaw shown in 4 partial exposures (from W. Meyer, in: Die Zahn-, Mund- und Kieferheilkunde, Vol. II, Munich-Berlin, 1955).
- Fig. 180. (Bottom) Roentgenograms of permanent teeth. Teeth of lower jaw shown in 4 partial exposures (from W. Meyer, in: Die Zahn-, Mund- und Kieferheilkunde, Vol. II, Munich-Berlin, 1955).

The Auditory and Vestibular Apparatus

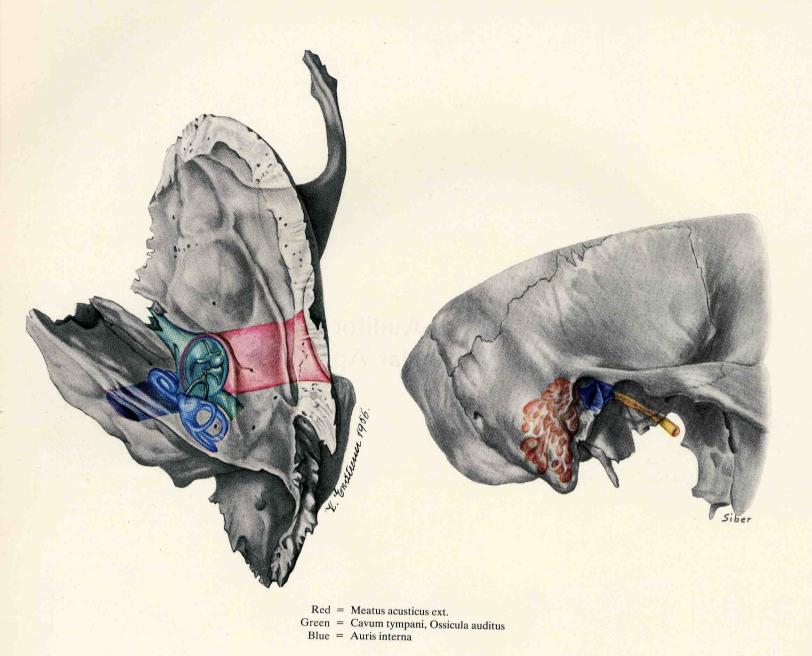


Fig. 181. (Left) The bony framework of the 3 subdivisions of the ear, depicted as translucent.

Fig. 182. (Right) Projection of the tympanic cavity (blue), the mastoid air cells (red), and the auditory tube (yellow) on the lateral surface of the skull.

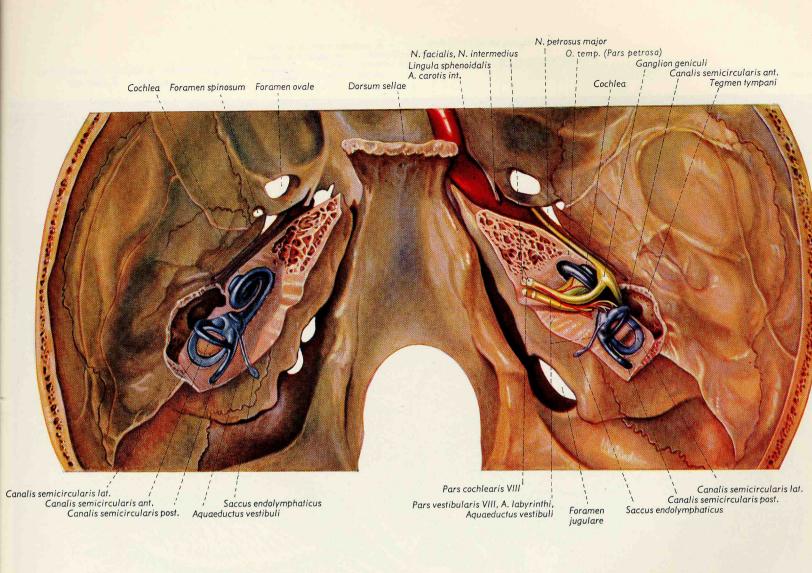


Fig. 183. The bony labyrinth, the vestibulocochlear nerve, and the facial nerve in situ in the petrosal bone. Metal cast of the labyrinth. The top of the pyramid has been chiseled out on both sides.

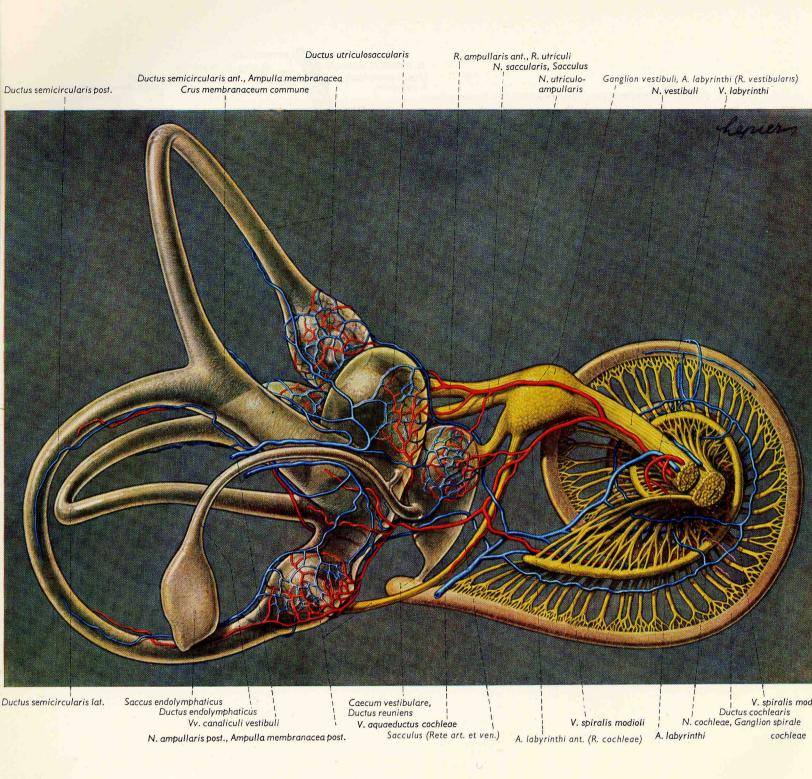


Fig. 184. Schematic representation of the left membranous labyrinth with vessels and nerves. Posteromedial view.

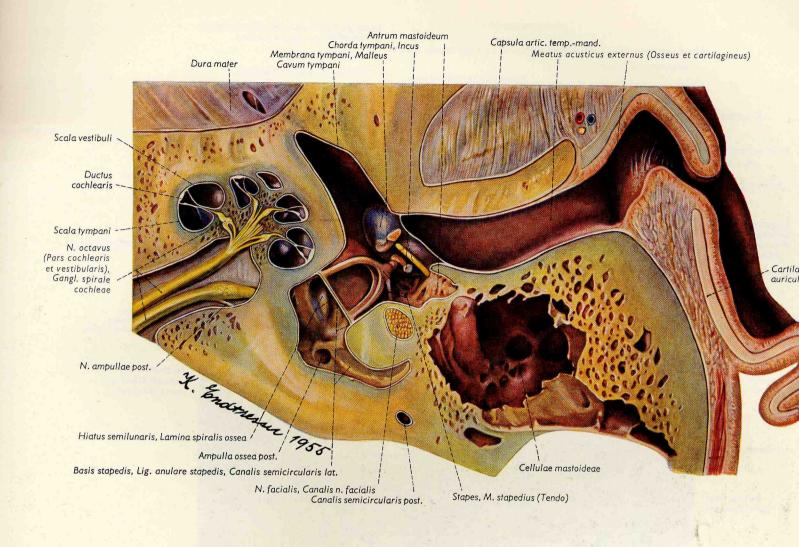


Fig. 185. Horizontal section through the ear at the level of the vestibular (oval) window. The cochlea has been cut axially; the floor of the vestibule and the lateral semicircular canal are illustrated. The stapes is intact, but the incus and malleus have been partly removed.

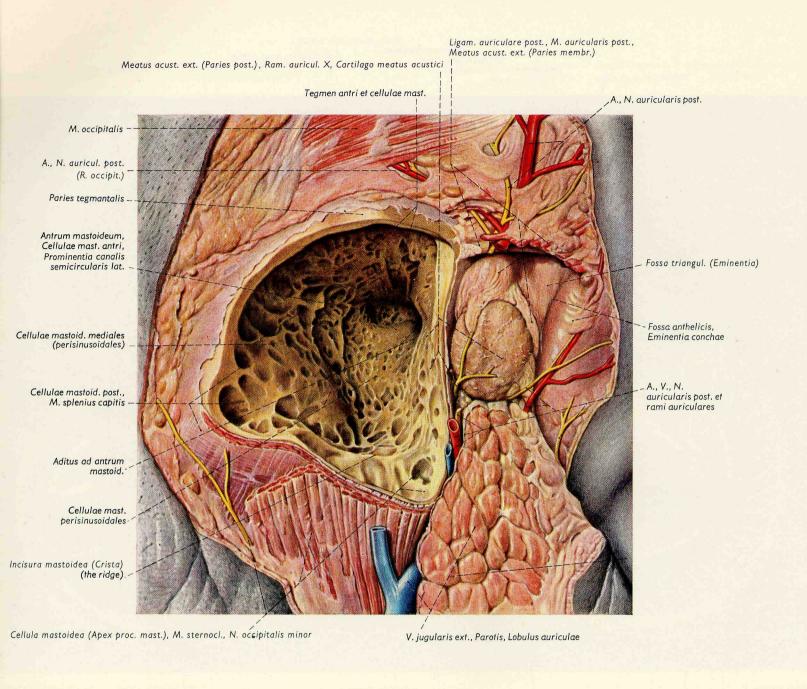


Fig. 186. Preparation of the mastoid air cells and antrum. The mastoid cells have been opened and partly removed, and the auricle has been reflected forward. The lateral wall of the mastoid cells was removed in such a way that no damage was done to the posterior bony wall of the external acoustic meatus. The tegmental wall (roof) was barely touched. The attachments of the sternocleidomastoid and splenius capitis muscles have been resected.

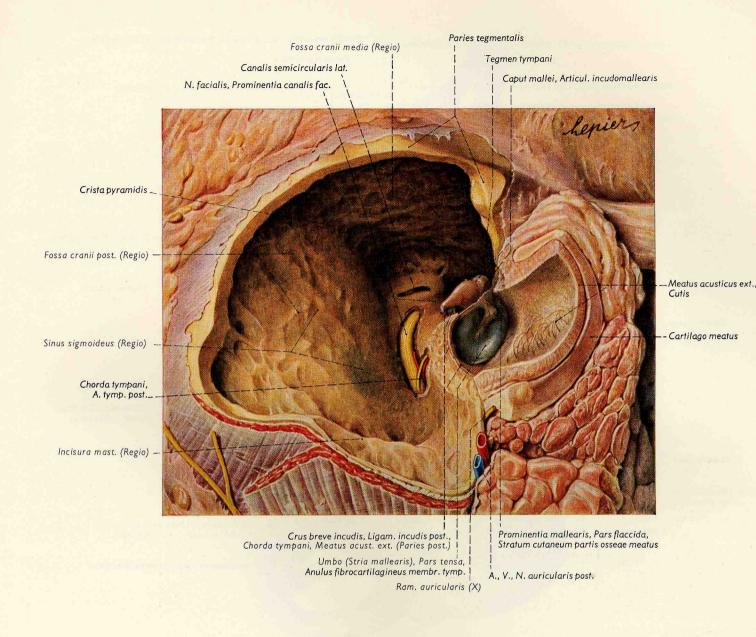


Fig. 187. Exposure of the outer components of the right ear through the mastoid region. The posterior wall of the external acoustic meatus was removed, and the descending part of the facial canal was opened. The mastoid cells were reamed out, and the lateral semicircular canal was opened.

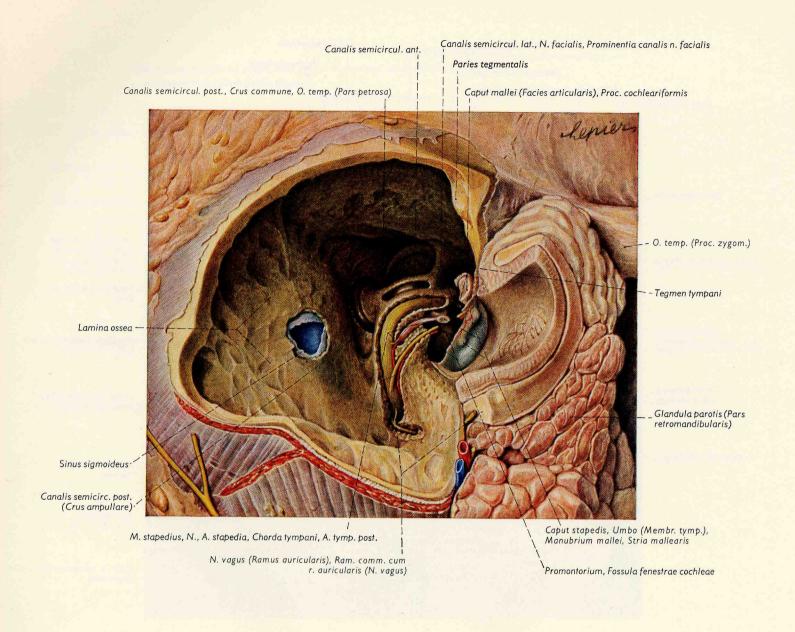
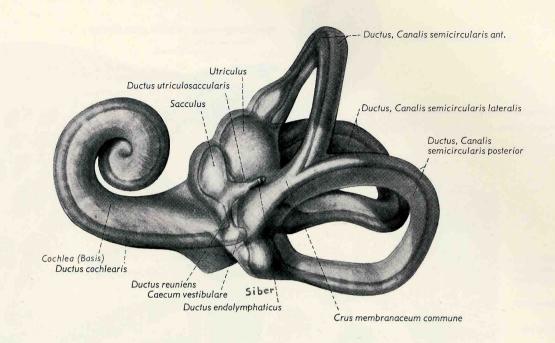


Fig. 188. Exposure of the right outer, middle, and inner ear through the mastoid region. The tympanic cavity with the stapes is opened; almost complete removal of the mastoid cells from the antrum. The sigmoid sinus is opened.



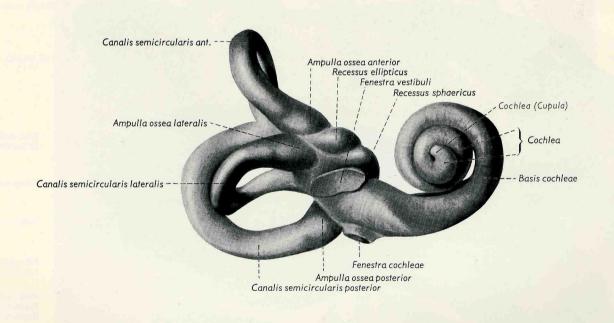
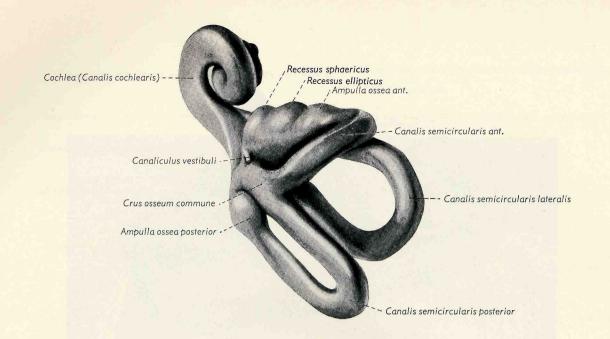


Fig. 189. (Top) Cast of the right bony labyrinth (the perilymphatic space) in a posteromedial view. The membranous labyrinth (the endolymphatic space) is illustrated as transparent.

Fig. 190. (Bottom) Cast of the right bony labyrinth in an anterolateral view.



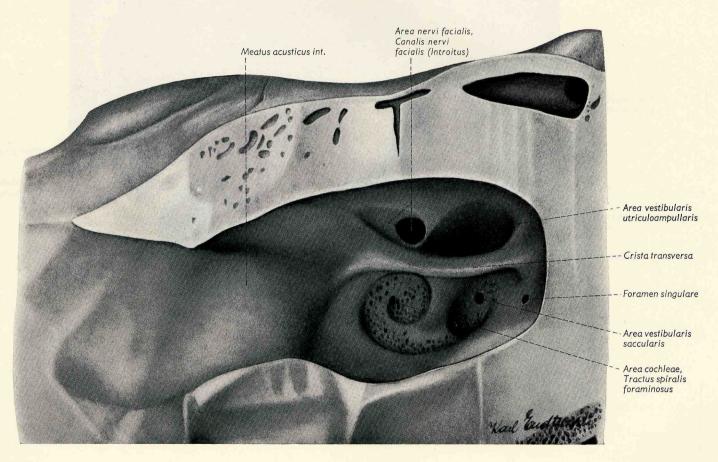


Fig. 191. (Top) Cast of right bony labyrinth seen from above.

Fig. 192. (Bottom) The fundus of the internal acoustic meatus on the right side. The internal acoustic meatus of a petrosal bone has been opened from behind.

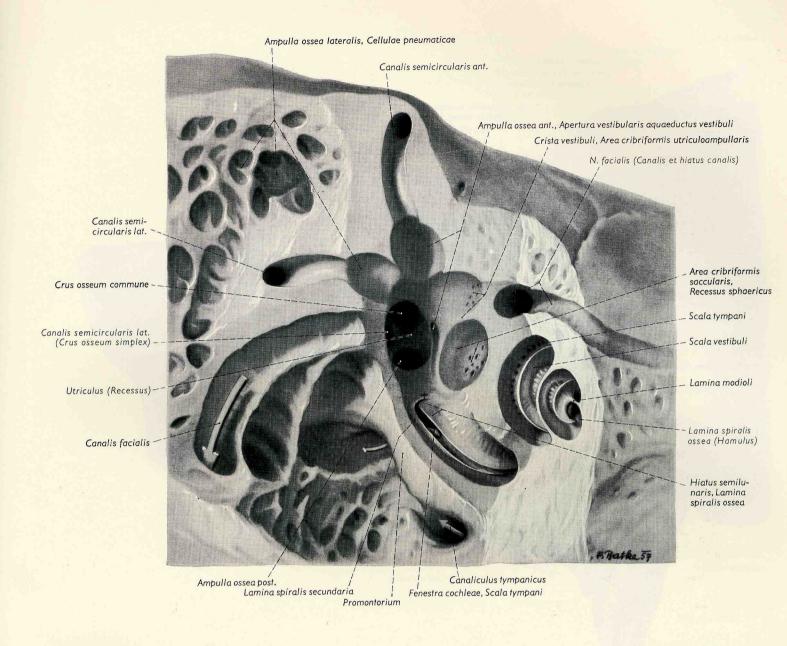


Fig. 193. A frontal section through the petrosal part of the right temporal bone showing the medial wall of the vestibule. The basal winding of the cochlea was opened so that scala vestibuli is facing the viewer.

Floor of the cochlear recess.

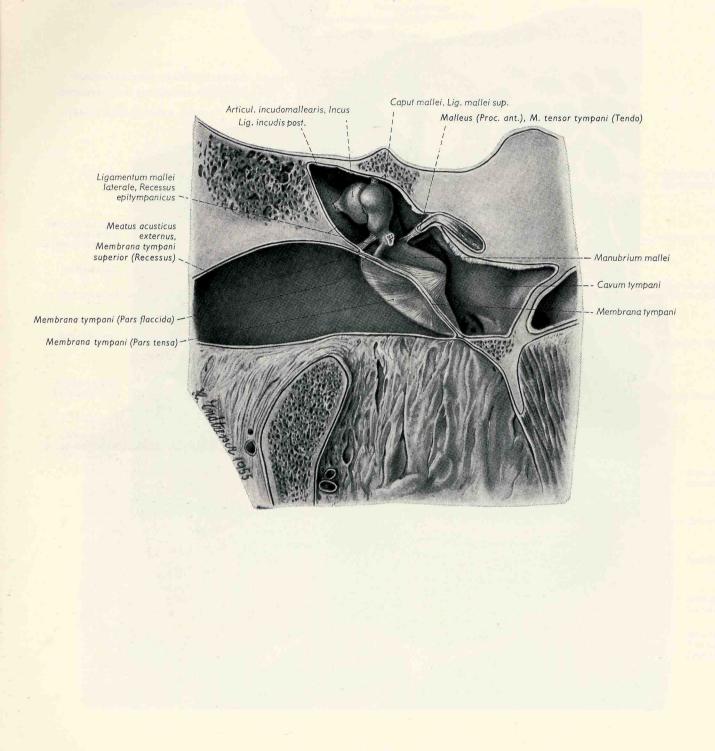


Fig. 194. Frontal section through the middle ear of the right side with mucosa and auditory ossicles.

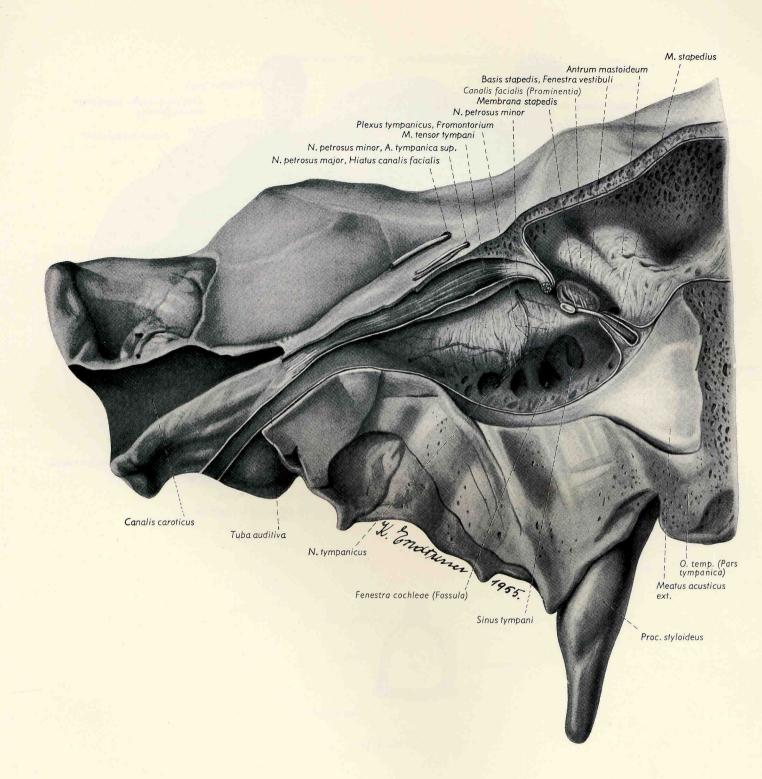


Fig. 195. Lateral view of the mucosal covering and muscles of the tympanic cavity. The malleus and incus were removed; the stapes is in situ.

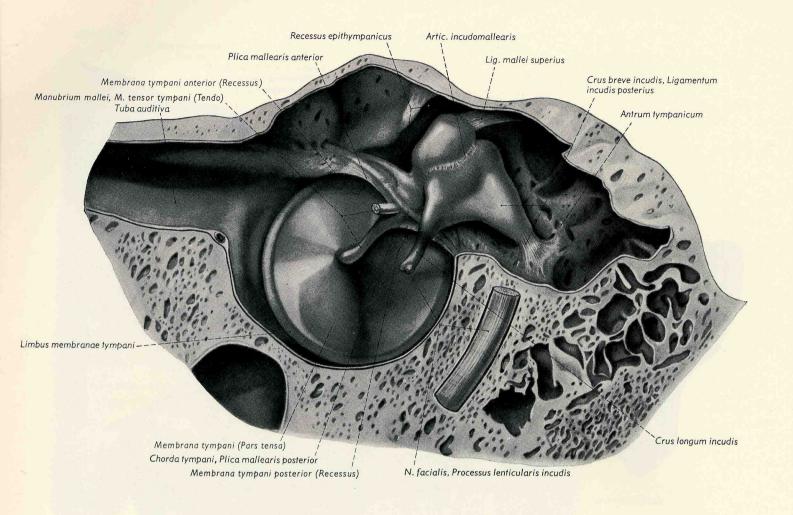
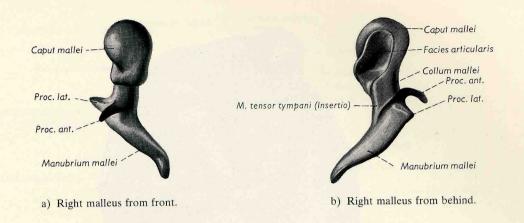


Fig. 196. The lateral wall of the right tympanic cavity. View of the tympanic membrane, the malleus, and the incus.



Crus breve

Corpus incudis

Crus longum

Facies articularis

Crus longum

Proc. lenticularis

C) Right incus, anterolateral view.

Crus breve

Crus breve

Crus breve

Crus longum

A corpus incudis

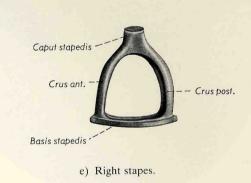
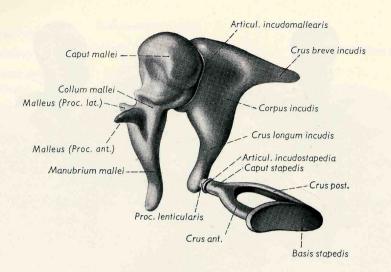


Fig. 197. View of the three auditory ossicles, disarticulated.



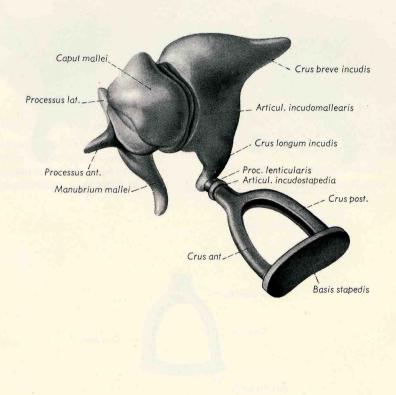
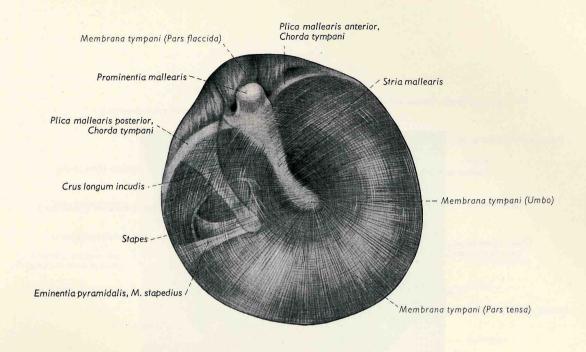


Fig. 198. (Top) The auditory ossicles of the right ear, medial view.

Fig. 199. (Bottom) The three articulated auditory ossicles, seen from above.



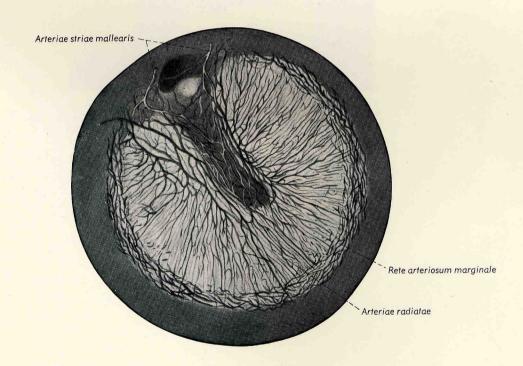
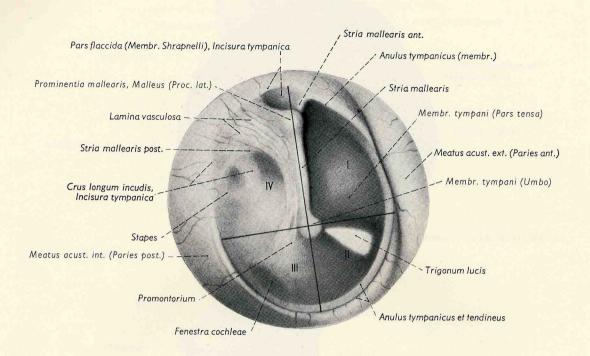


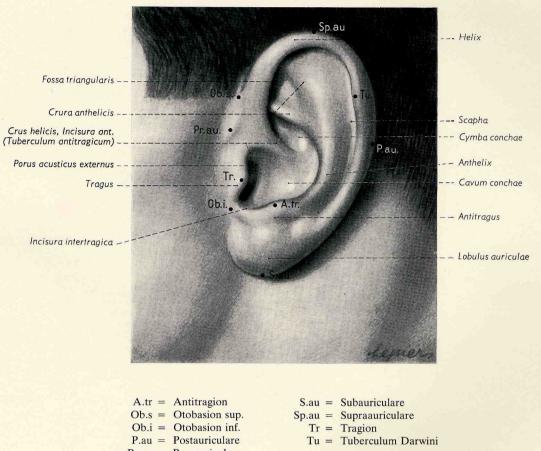
Fig. 200. (Top) The three auditory ossicles projected on the right eardrum to show their location, lateral view.

Fig. 201. (Bottom) The eardrum with its arteries.



I = Anterior superior quadrant of eardrum
 II = Anterior inferior quadrant of eardrum
 III = Posterior inferior quadrant of eardrum
 IV = Posterior superior quadrant of eardrum

Fig. 202. Otoscopic view of right eardrum (from von Eicken-Schultz v. Treeck).

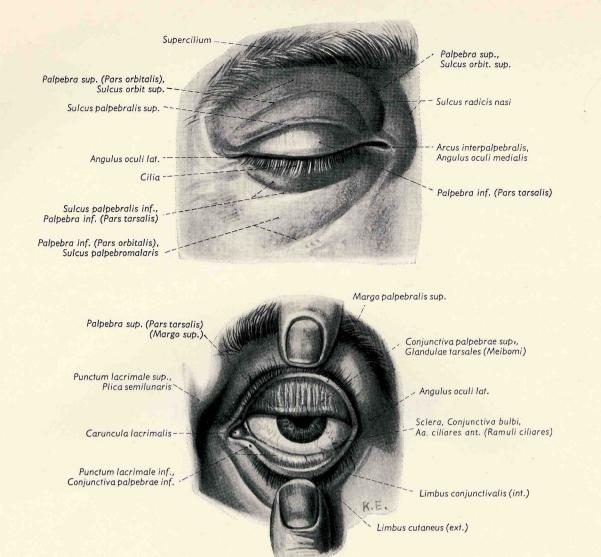


Ob.s = Otobasion sup. Ob.i = Otobasion inf.

P.au = Postauriculare Pr.au = Praeauriculare

Fig. 203. Lateral auricular region (external ear). The surface within the auricle.

The Eye and the Orbit



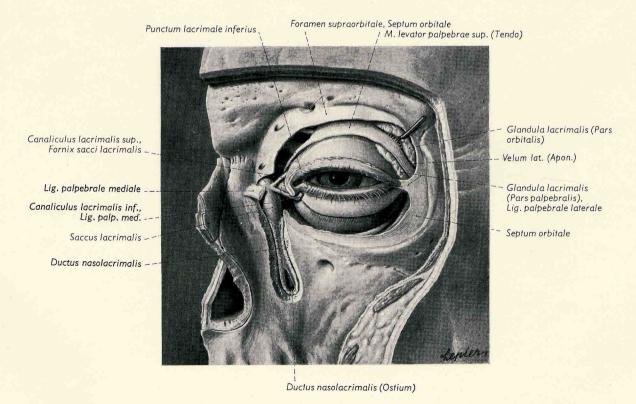
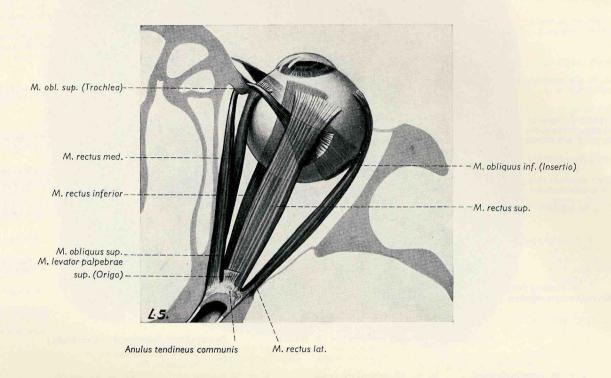


Fig. 204. (Top) External features of right eye region.

Fig. 205. (Middle) External features of the left eye region. The upper lid is completely inverted; the lower lid is pulled down:

Fig. 206. (Bottom) The lacrimal apparatus and the tarso-orbital septum (partly resected).



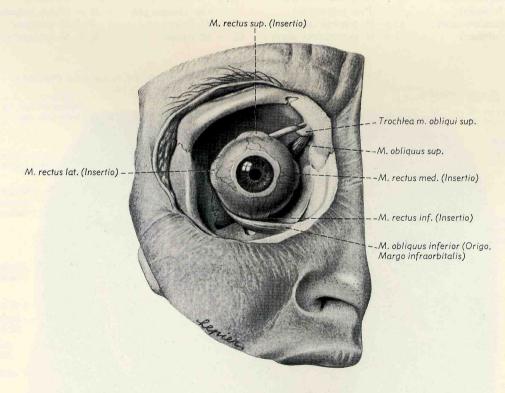


Fig. 207. (Top) Schematic view of the muscles of the right eyeball seen from above. The muscles are drawn partly transparent. Note the deviation of the bulbar axis and the components of the muscle "pyramid."

Fig. 208. (Middle) Muscles of the right eyeball seen from front.

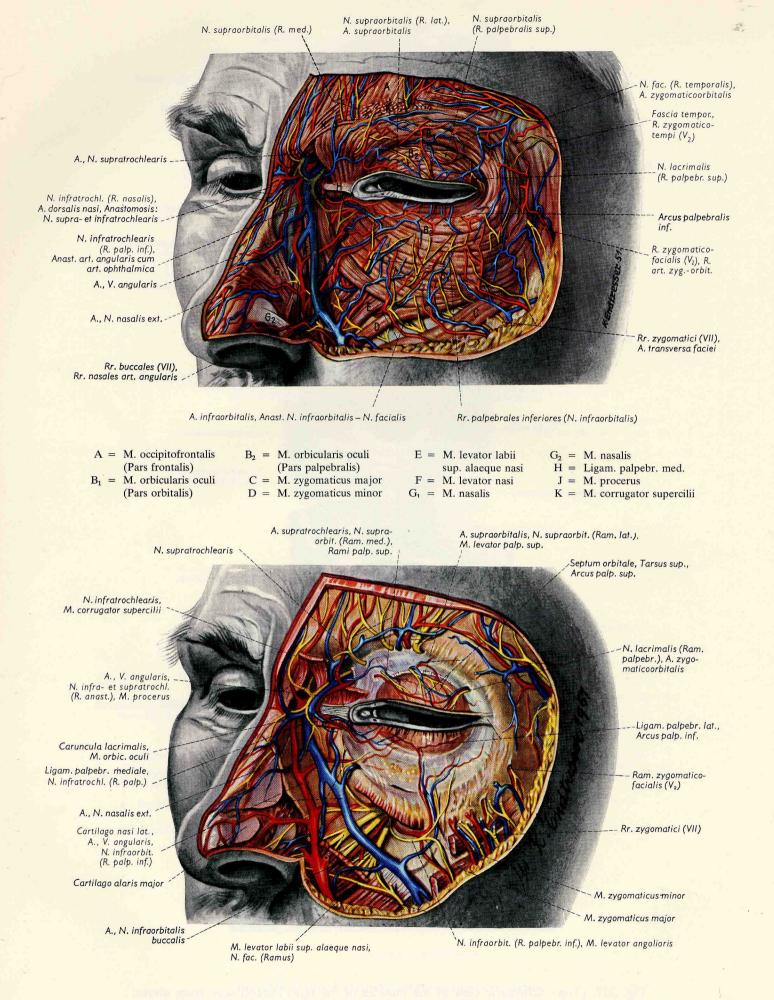
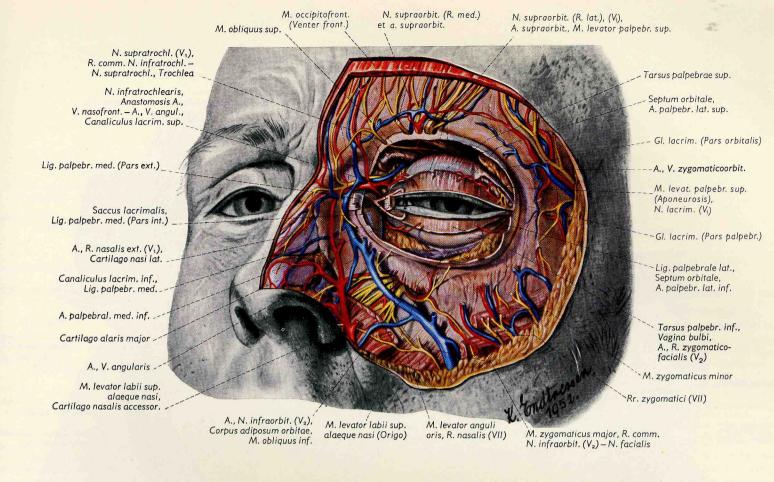


Fig. 209. (Top) Vessels, nerves, and muscles in the superficial eye and nose regions.

Fig. 210. (Bottom) Vessels and nerves of the face in the deeper eye and nose regions after partial removal of the mimic musculature.



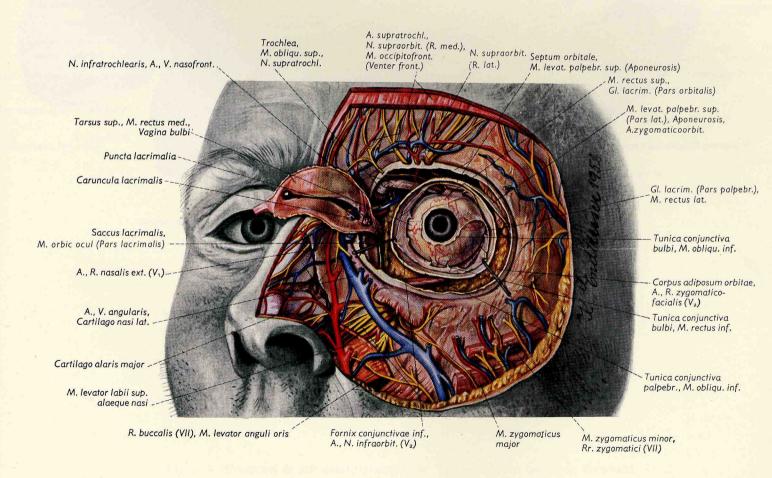


Fig. 211. (Top) Blood vessels and nerves of the deep eye region and lateral aspect of nose seen from front.

Fig. 212. (Buttom) Ocular bulb in situ, from front. The orbital septum is incised and the upper and lower tarsal plates are reflected medially.

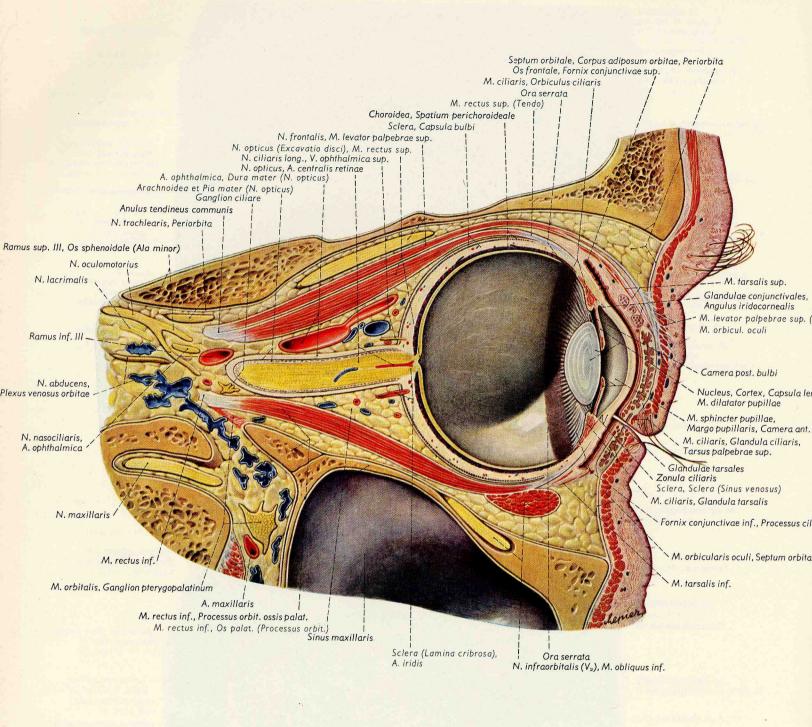


Fig. 213. Lateral view of a sagittal section through the orbit with contents.

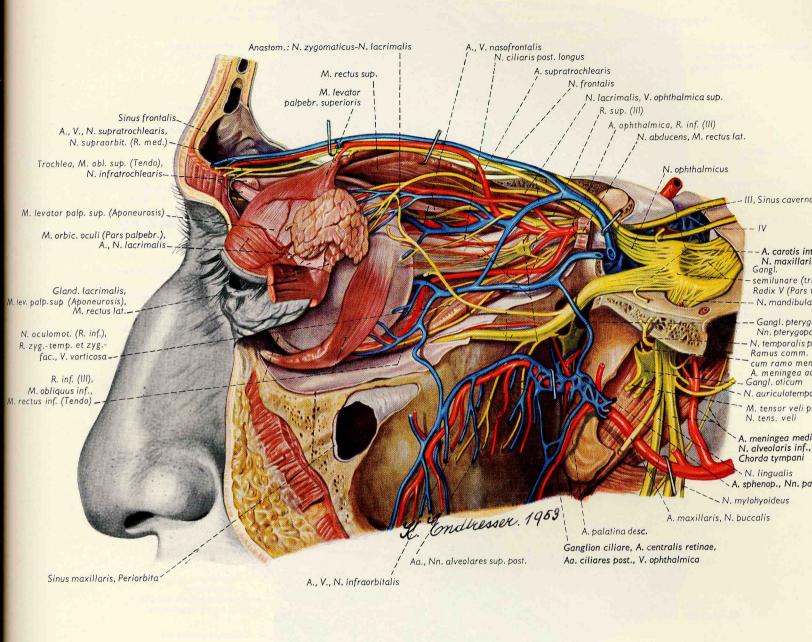
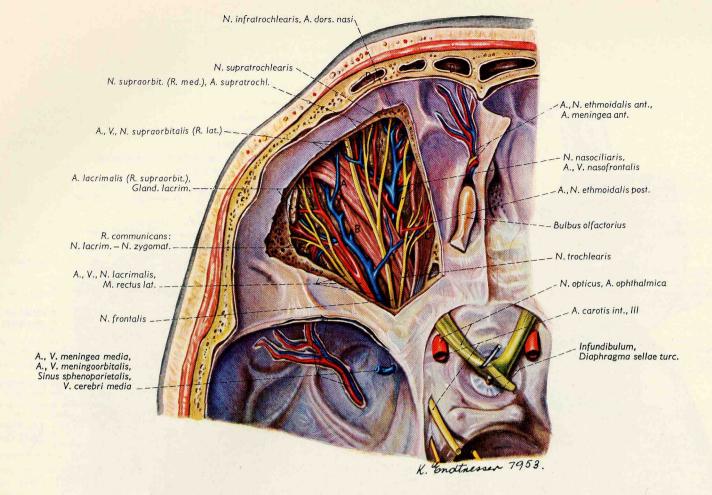


Fig. 214. Contents of left orbit, lateral view. The orbital fat has been removed. Pterygopalatine fossa with the pterygopalatine ganglion.



A = M. levator palp. sup.

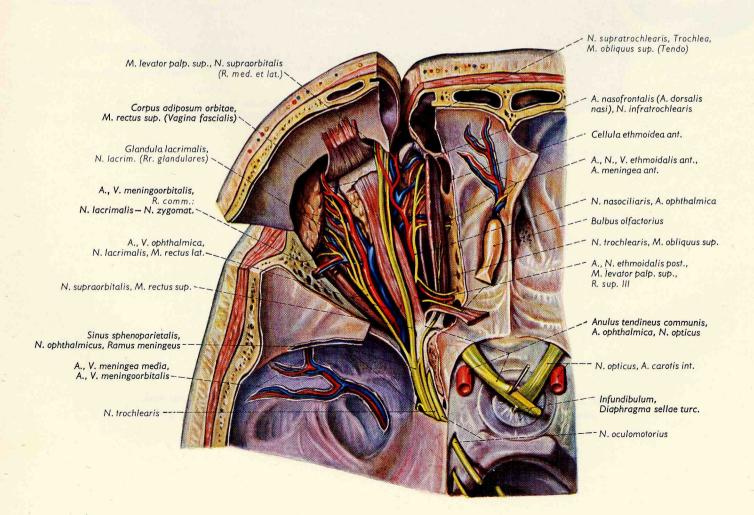
B = M. rectus sup.

C = M. obliquus sup.

D = Sinus frontalis

 D_1 = Sinus frontalis (Recessus lat.)

E = Cellula ethmoidea post.



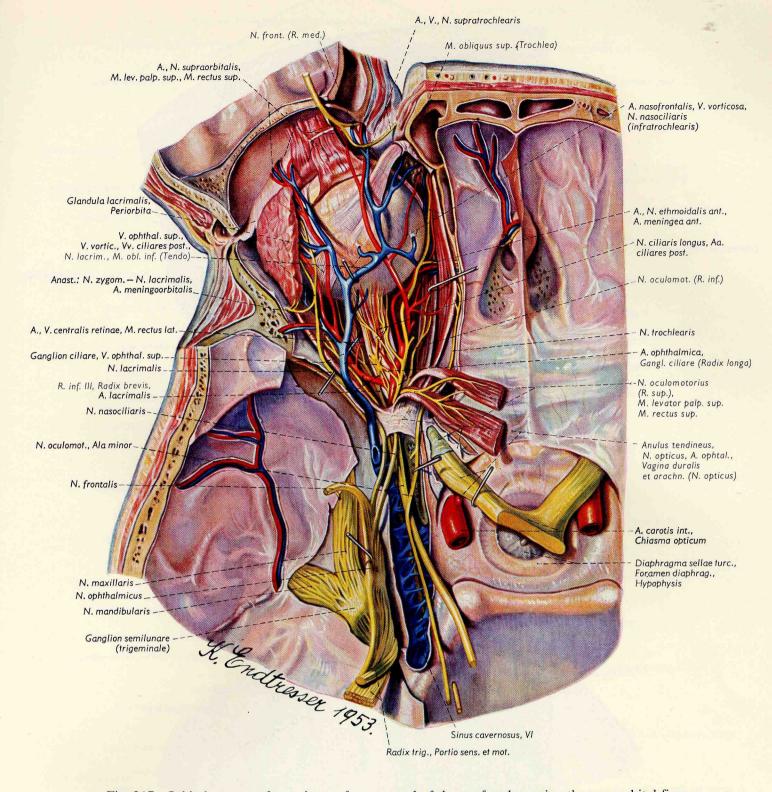
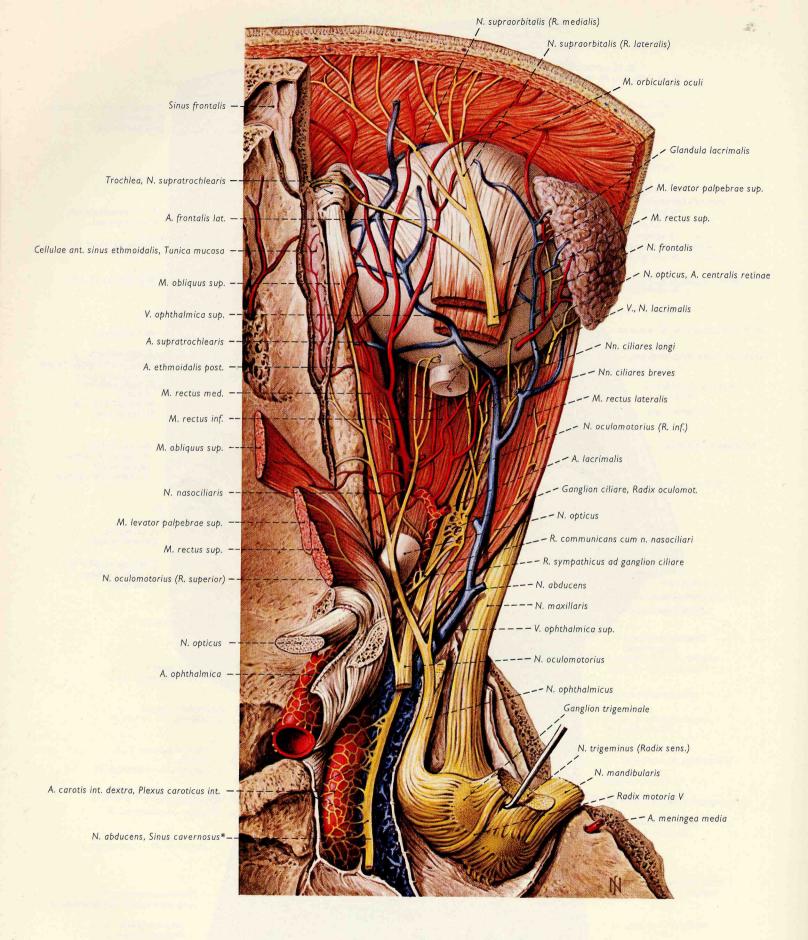


Fig. 217. Orbital contents from above after removal of the roof and opening the sup. orbital fissure.

The levator palp. sup. has been cut and reflected back.

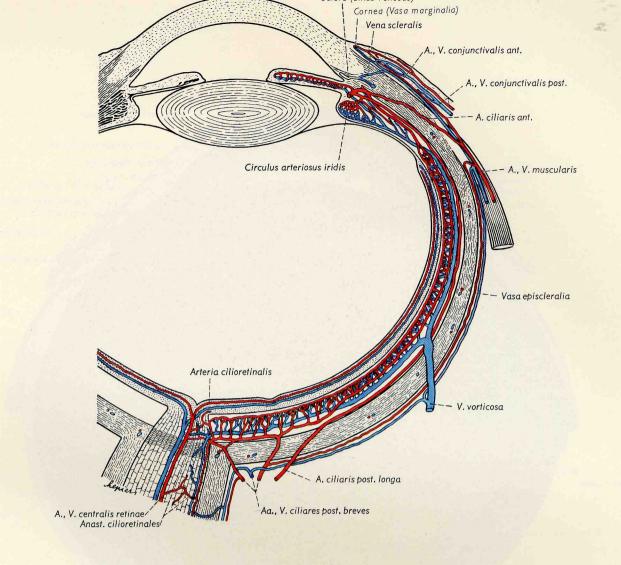
Fig. 215. (Left, top) View of muscles, nerves, and vessels of the orbit from above after removal of the orbital roof.

Fig. 216. (Left, bottom) Orbital contents from above after removal of the orbital roof. The nerves in the region of the cavernous sinus. Area of the hypophysis from above.



^{* =} Branching sympathetic fibers to the abducens n. from the internal carotid plexus in the cavernous sinus.

Fig. 218. Right orbit, opened from above. The superior orbital wall and squama of the frontal bone have been removed to show the branching of the 1st division of the trigeminal nerve. The semilunar ganglion and the trigeminal nerve are elevated.



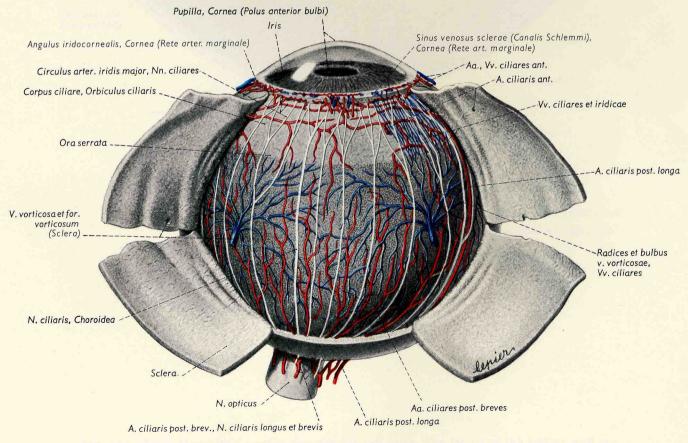


Fig. 219. (Top) Blood vessels of the bulb; schematic (from Th. Leber).

Fig. 220. (Bottom) Right ocular bulb seen from above. The sclera is reflected, exposing the vessels and nerves of the vascular tunic of the bulb.

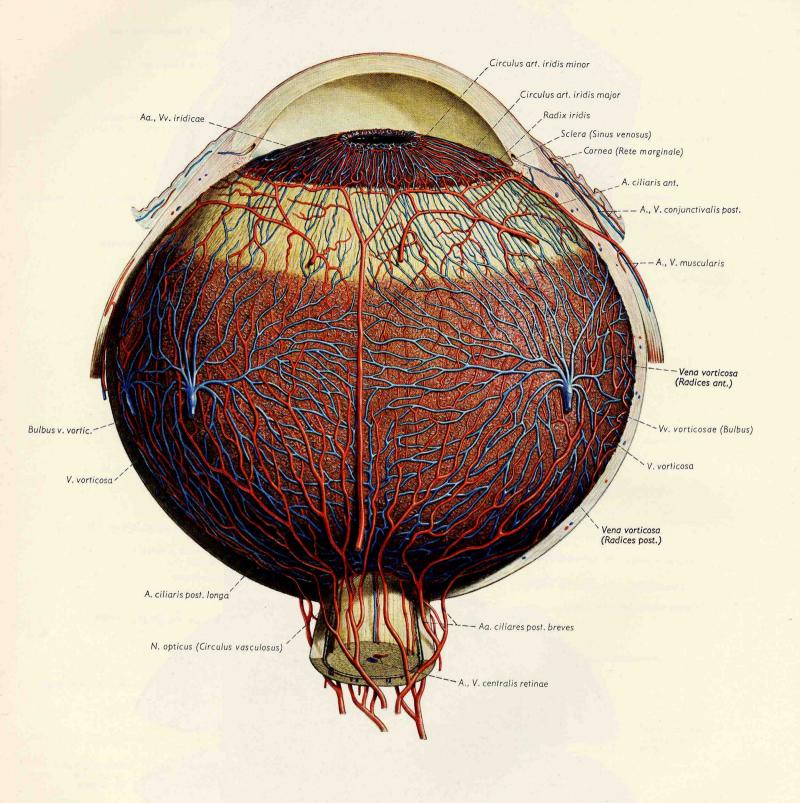


Fig. 221. Blood vessels in the middle layer of the bulb.

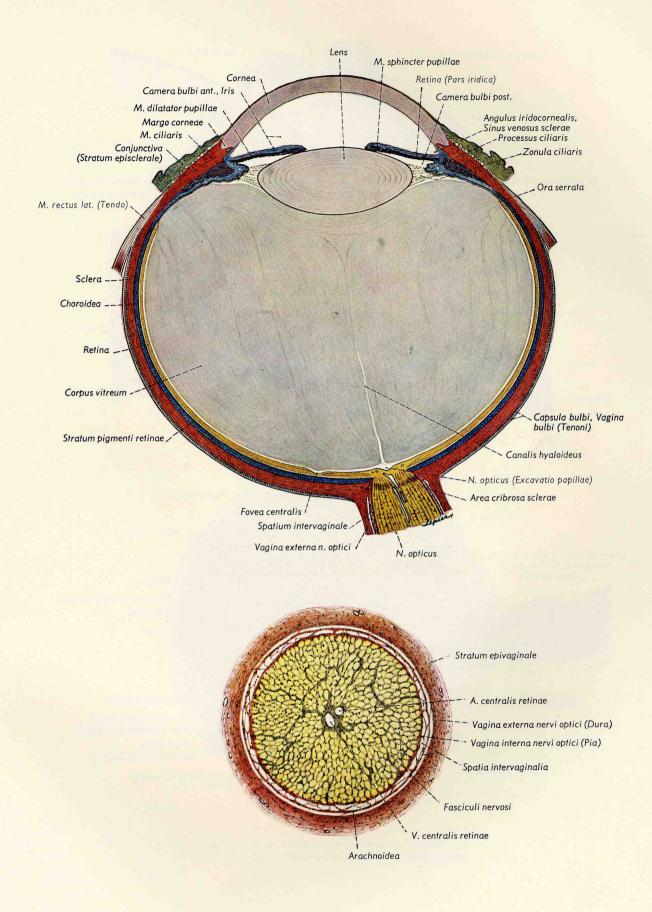
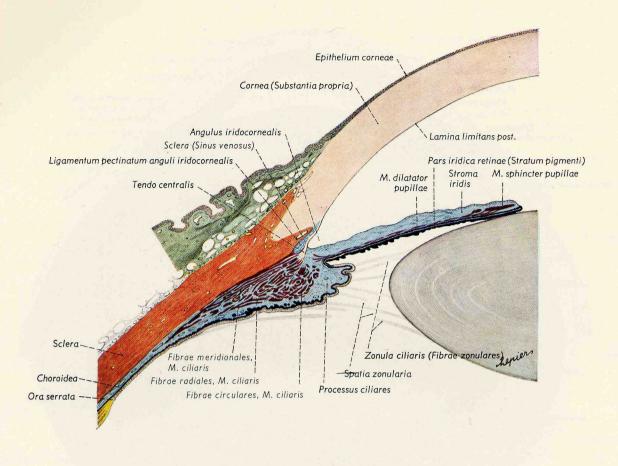


Fig. 222. (Top) Horizontal section through the left bulb. The layers of the bulbar wall are indicated by different colors.

Fig. 223. (Bottom) Cross section through the anterior part of the optic nerve.



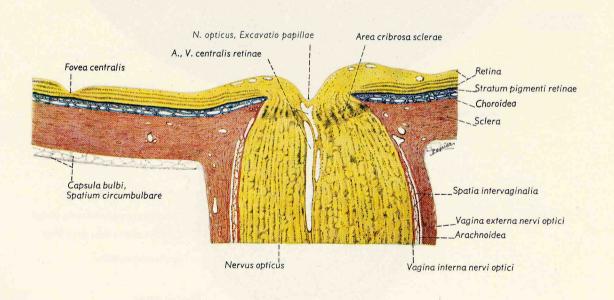
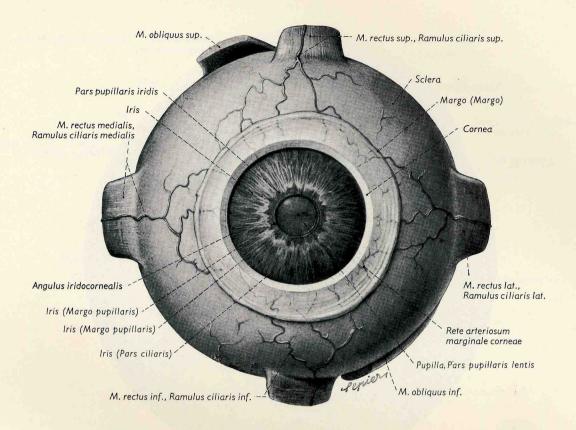


Fig. 224. (Top) Horizontal section through the optic nerve at its point of entrance into the bulb.

Fig. 225. (Bottom) Horizontal section through the anterior portion of the bulb.



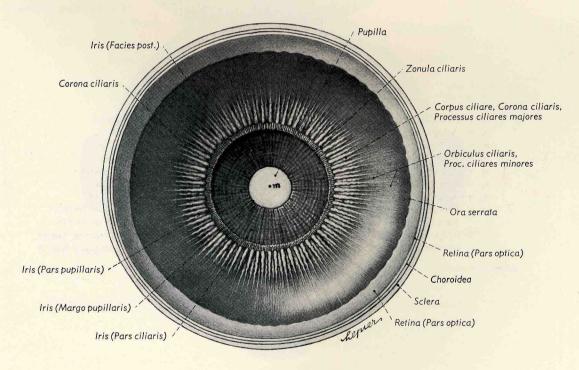
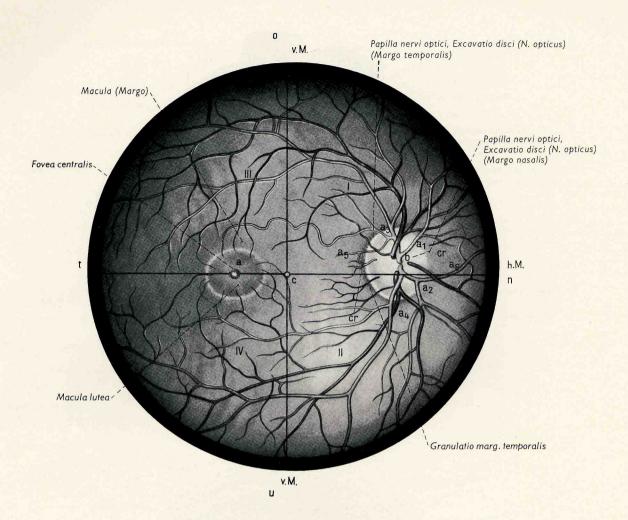


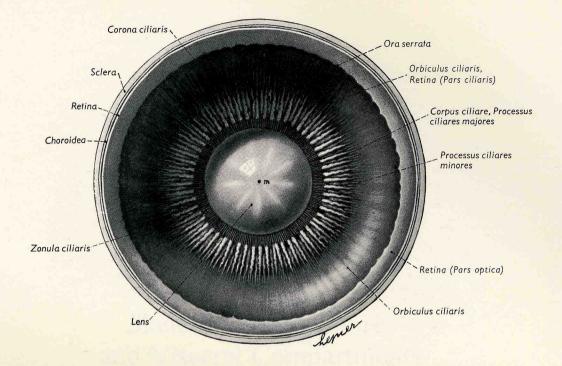
Fig. 226: m = Center of the anterior lens surface Fig. 227: m = Center of the posterior corneal surface

Fig. 226. (Top) Ocular bulb from front. The cornea of the left bulb was incised circularly near the corneal edge and removed; the anterior chamber of the eye was opened, and the iris was exposed.

Fig. 227. (Bottom) Anterior portion of the bulb seen from the inside.



a = Fovea centralis cr = cilioretinal anastomoses a₁ = Arteriola nasalis retinae sup. h.M = horizontal meridian a₂ = Arteriola nasalis retinae inf. n = nasal aspect of fundusa₃ = Arteriola temporalis sup. o = upper aspect of fundus a_4 = Arteriola temporalis inf. t = temporal aspect of fundus a₅ = Arteriolae maculares u = lower aspect of fundus a₆ = Arteriola medialis retinae v.M = vertical meridian b = Papilla (Discus) n. optici, I = upper nasal quadrant of fundus Excavatio papillae II = lower nasal quadrant of fundus III = upper temporal quadrant of fundus IV = lower temporal quadrant of fundus c = midpoint of fundus (posterior pole of eyeball)



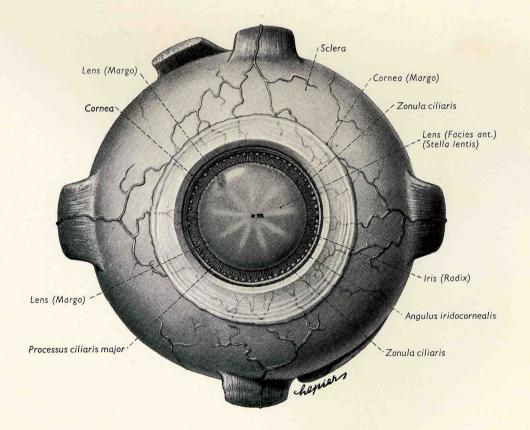


Fig. 229. (Top) View into the anterior half of the eye from behind after removal of the vitreous body.

Fig. 230. (Bottom) Lens and suspensory apparatus from front. On the left bulb the iris was circularly incised near its root and lifted out so as to expose the lens.

The Neck

Skeleton, Musculature, and Visceral Compartments

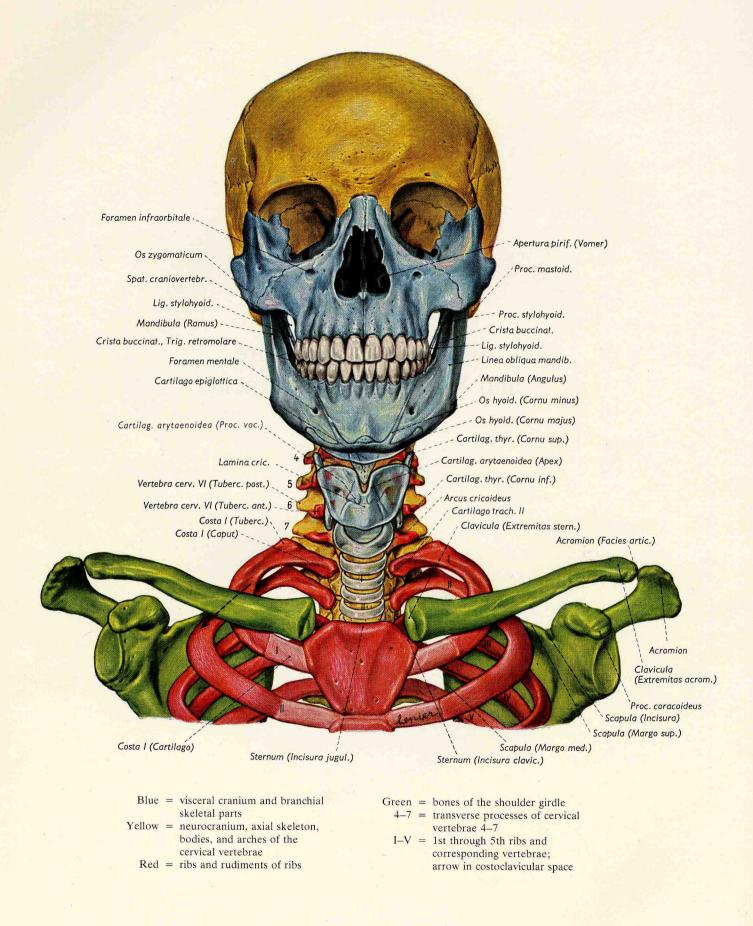
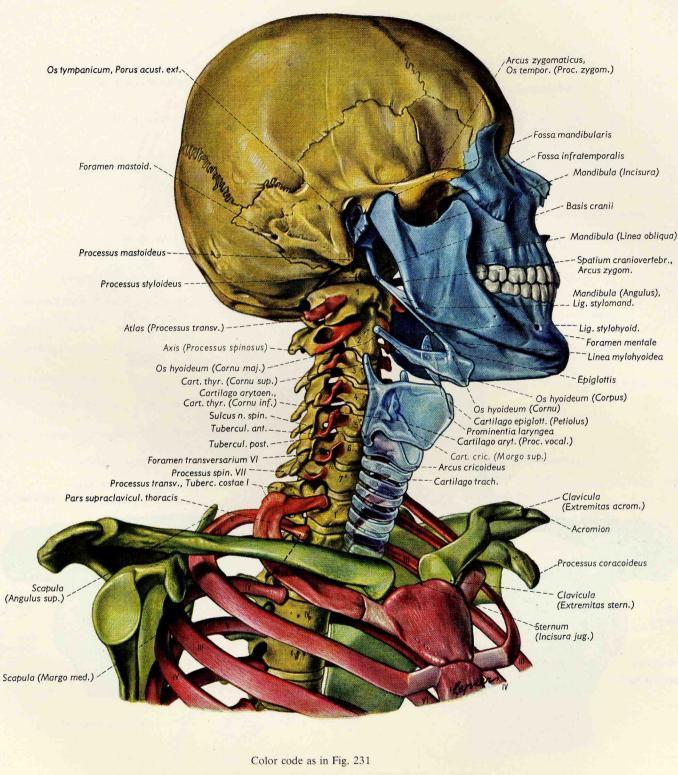


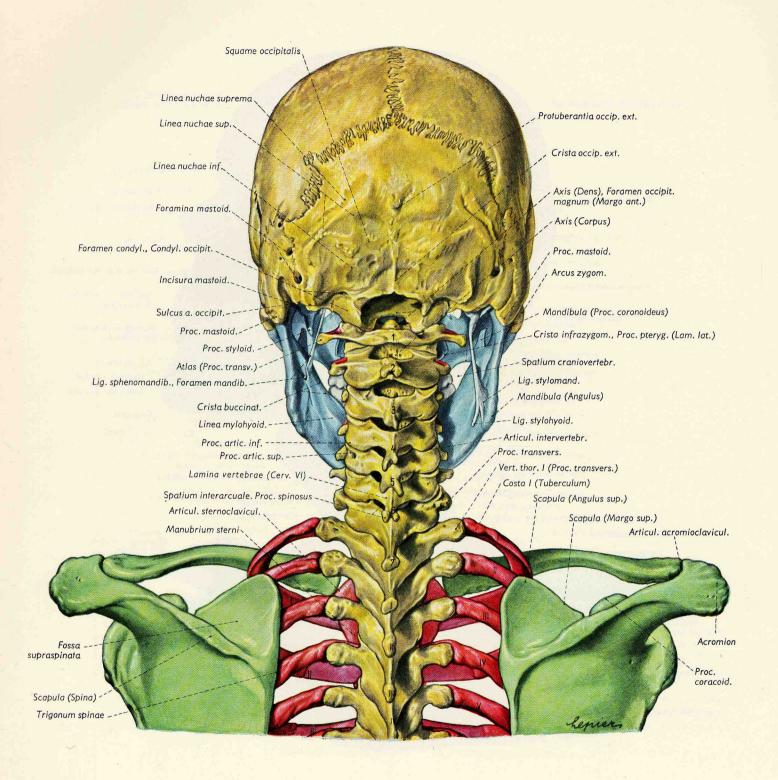
Fig. 231. Skeleton of head and neck seen from front.



1-7 = bodies of the 7 cervical vertebrae

I–V = ribs and corresponding thoracic vertebrae; arrow in the costoclavicular space

Fig. 232. Skeleton of the head and neck. Viewed from the right side with the head turned slightly to the left.



1–7 = spinous processes of the 7 cervical vertebrae

I-V = spinous processes of the upper 4 thoracic vertebrae and the upper 5 ribs

Fig. 233. Skeleton of the head and neck and the adjoining parts of the thorax. Dorsal view with the head bent slightly forward.

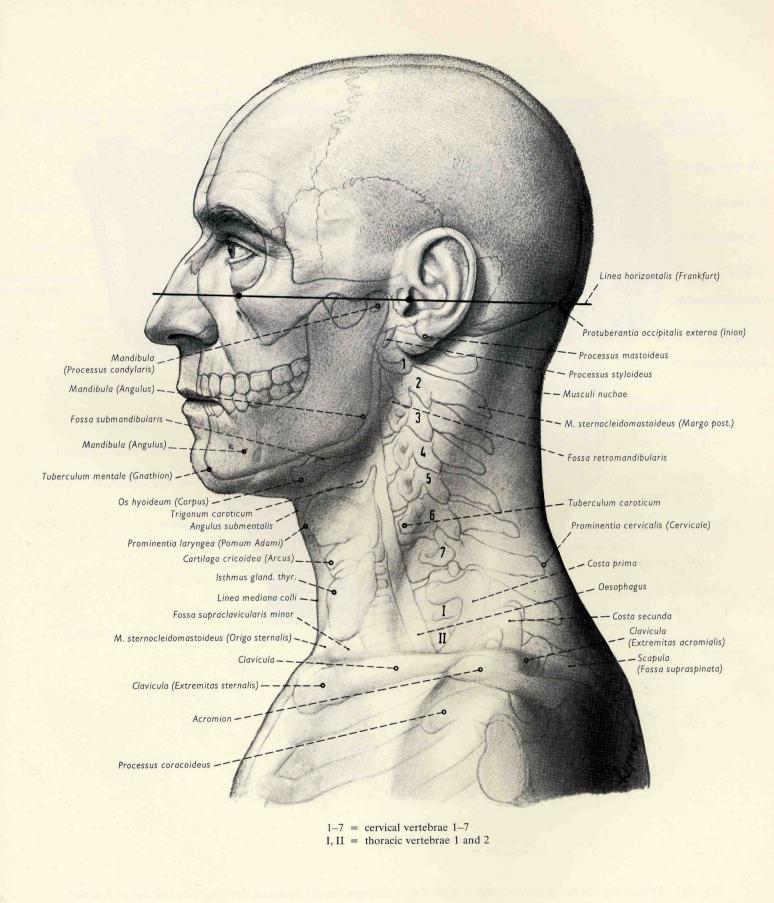


Fig. 234. Exterior of neck (viewed from the side with skeletal parts and viscera drawn in). Palpable skeletal landmarks are indicated by o.

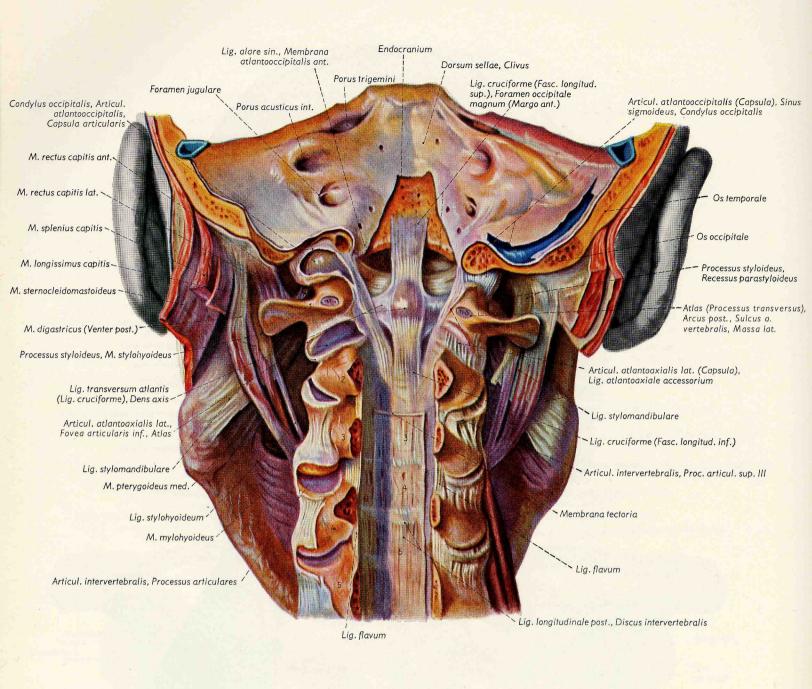


Fig. 235. Dorsal view of the craniovertebral joints. The joint capsules are intact on the right side and opened on the left side. The tectorial membrane has been removed from the anterior wall of the vertebral canal so that the proper ligaments of the craniovertebral joints (cruciform and alar ligaments) may be seen (drawn by K. Endtresser, 1951).

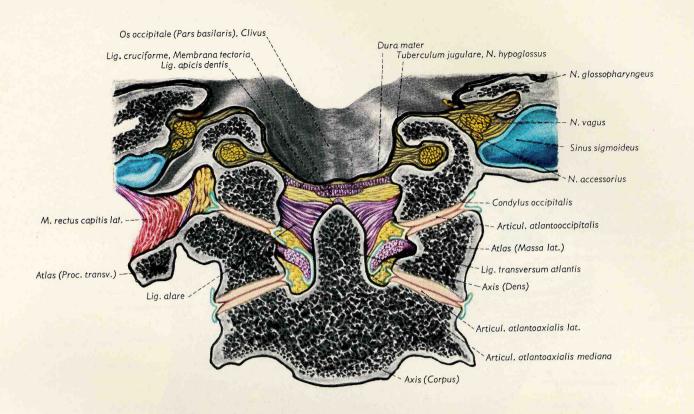


Fig. 236. Frontal section through the region of the craniovertebral joints. Dorsal view of the cut surface.

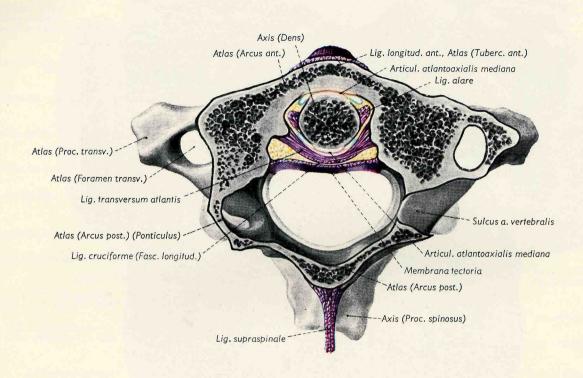


Fig. 237. Transverse section through the region of the craniovertebral joints at the level of atlas (viewed from above).

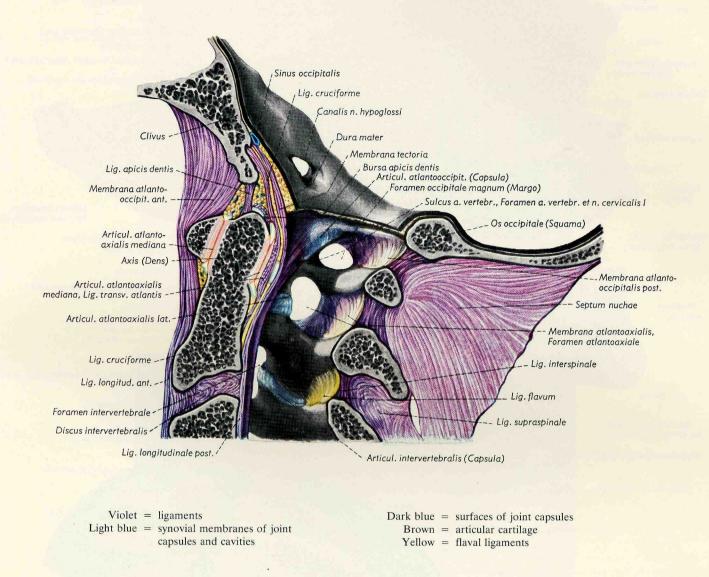
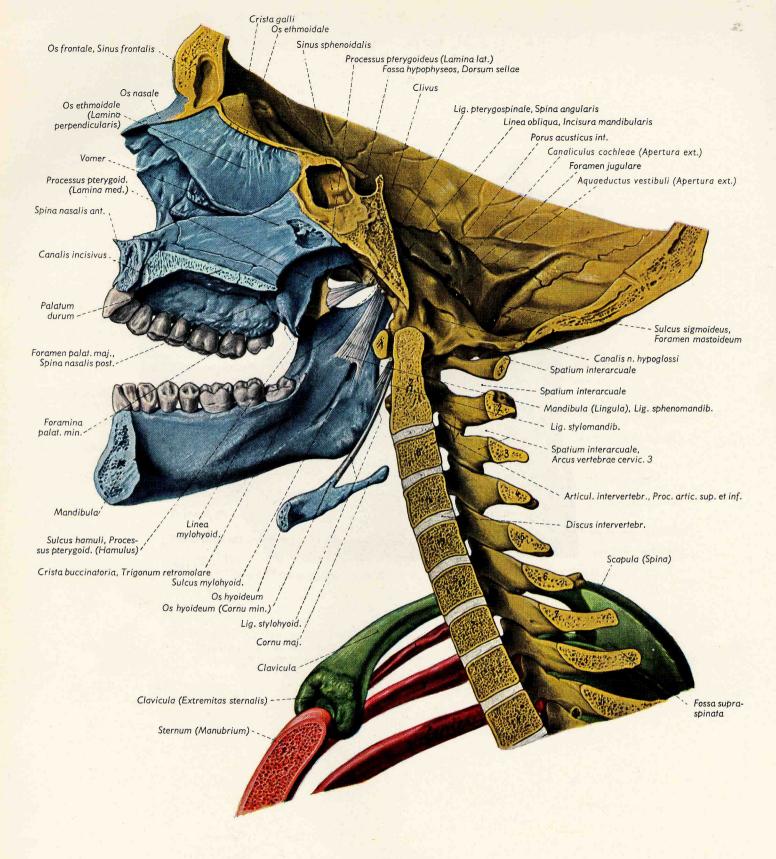


Fig. 238. Midsagittal section through the region of the craniovertebral joints (right half).



1–7 = bodies and spinous processes of cervical vertebrae 1–7

I-III = ribs and associated thoracic vertebrae

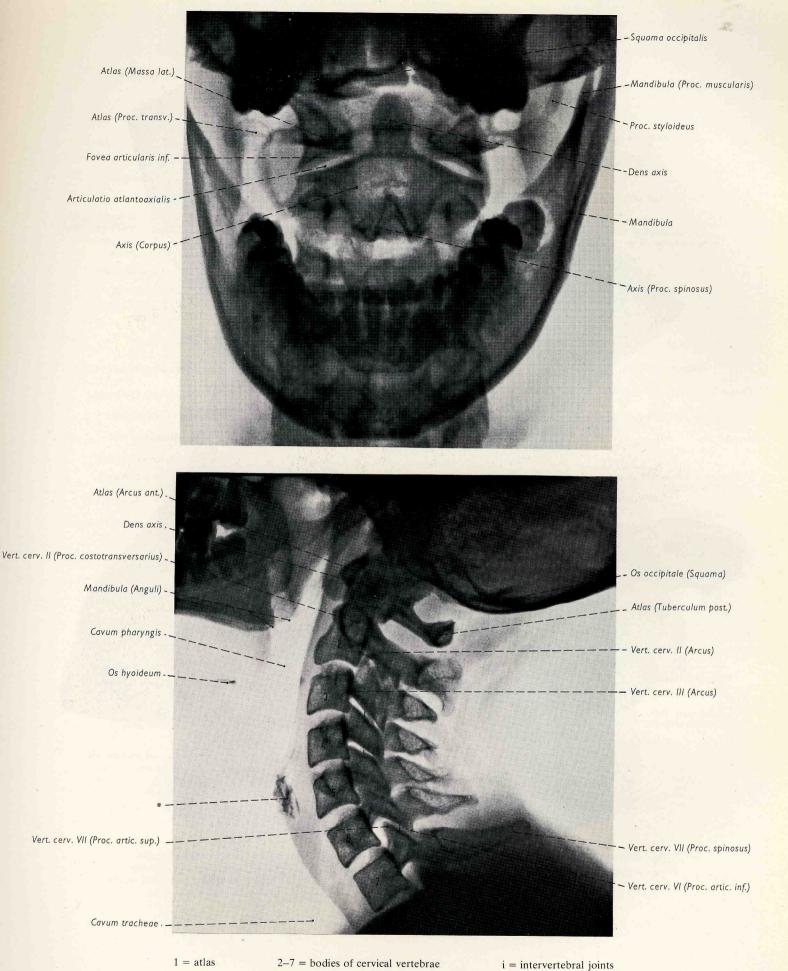


Fig. 240. (Top) Roentgenogram of cranial end of cervical vertebral column, anteroposterior view through mouth (L. Wicke, Vienna).

* = Cartilago cricoidea

Fig. 241. (Bottom) Roentgenogram of adult cervical vertebral column, lateral view, head in normal, standing posture (L. Wicke, Vienna).

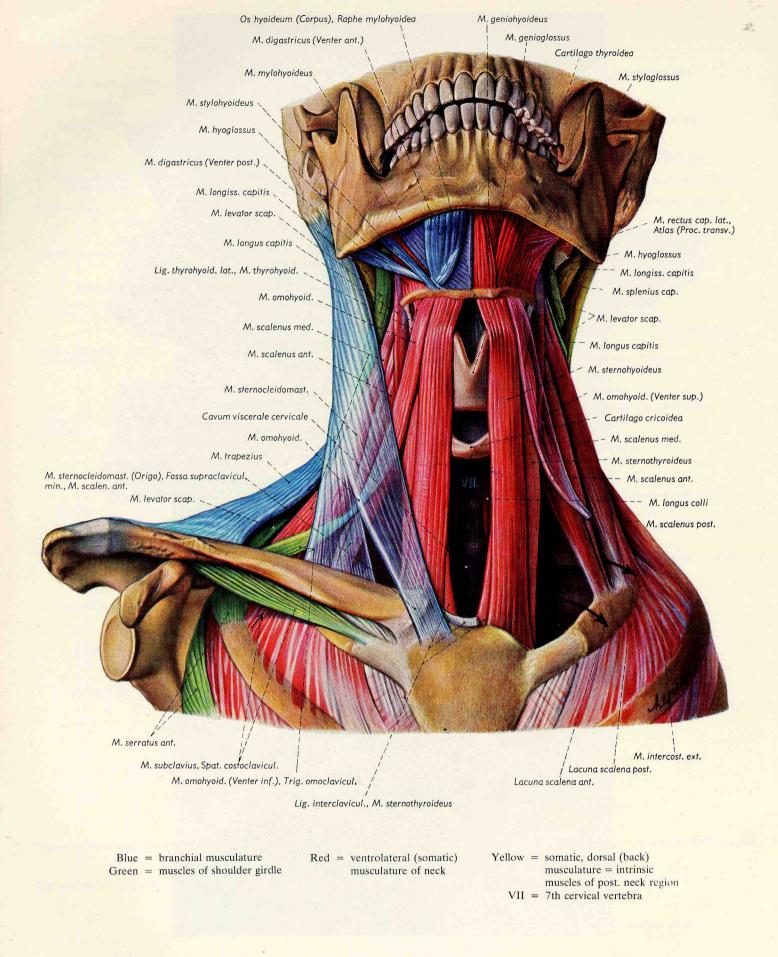
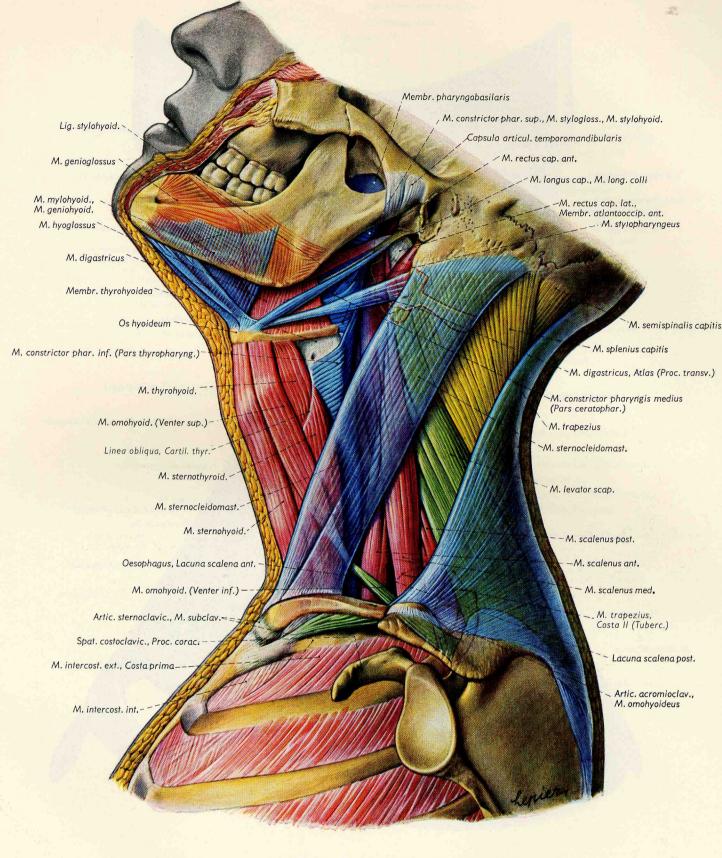
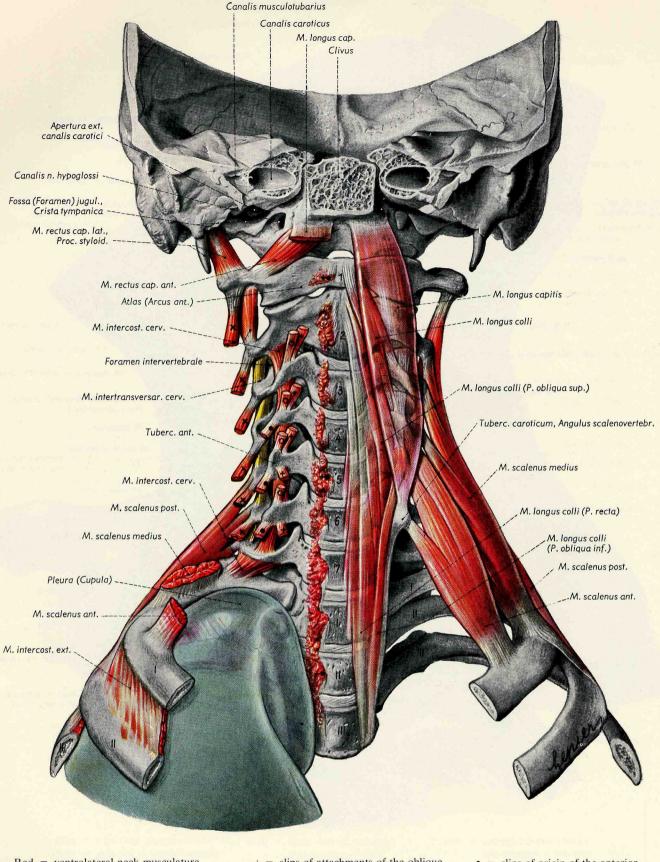


Fig. 242. Musculature of the neck. Front view (neurovascular bundles and viscera removed). The left shoulder girdle and associated muscles have been resected so that the suprahyoid tongue musculature and the infrahyoid ventrolateral neck muscles and scalene lacunae (anterior and posterior, arrows) may be seen.



Color code as in Fig. 242 Brown line = outline of atlas

Fig. 243. Neck musculature seen from the left side; head bent backward.



Red = ventrolateral neck musculature

Yellow = dorsal musculature

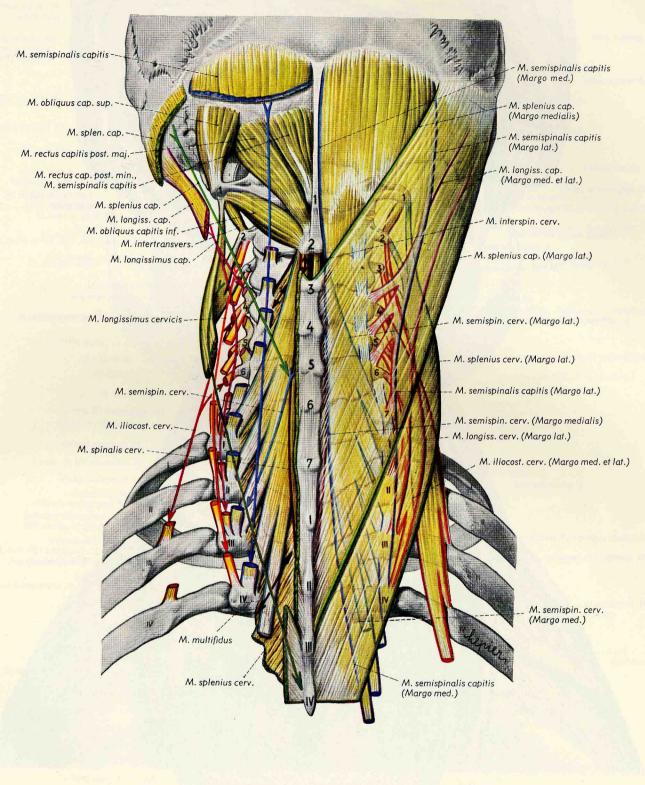
1-7 = cervical vertebrae 1-7I-III = thoracic vertebrae 1-3 and

corresponding ribs

= slips of attachments of the longus colli m. on the bodies of the vertebrae

- + = slips of attachments of the oblique parts of longus colli m. on the transv. proc. (ant. tubercle)
- slips of origin of longus capitis m. on the transv. proc. (ant. tubercle)
- = slips of origin of the anterior scalene m. on the transv. proc. (ant. tubercle)
- \times = slips of origin of the middle scalene m. on the transv. process (post. tubercle)

Fig. 244. Prevertebral and paravertebral neck musculature. The left longus capitis muscle has been drawn transparent; on the right side the muscles have been removed from their sites of attachment so that the smaller cervical intercostal and intertransverse muscles may be seen. The cupula of the right pleura is retained.



I–IV = spinous and transverse processes of thoracic vertebrae 1–4 and corresponding ribs 1–7 = spinous and transverse processes of cervical vertebrae 1–7

Fig. 245. The intrinsic muscles of posterior neck region (schematic, seen from behind) toned yellow and outlined in different colors. The superficial muscles on the right side are drawn transparent; on the left side only the origins and/or the insertions are indicated in order to bring into view the underlying muscles. The directions of pull of the muscles on the left side are indicated by arrows in appropriate colors.

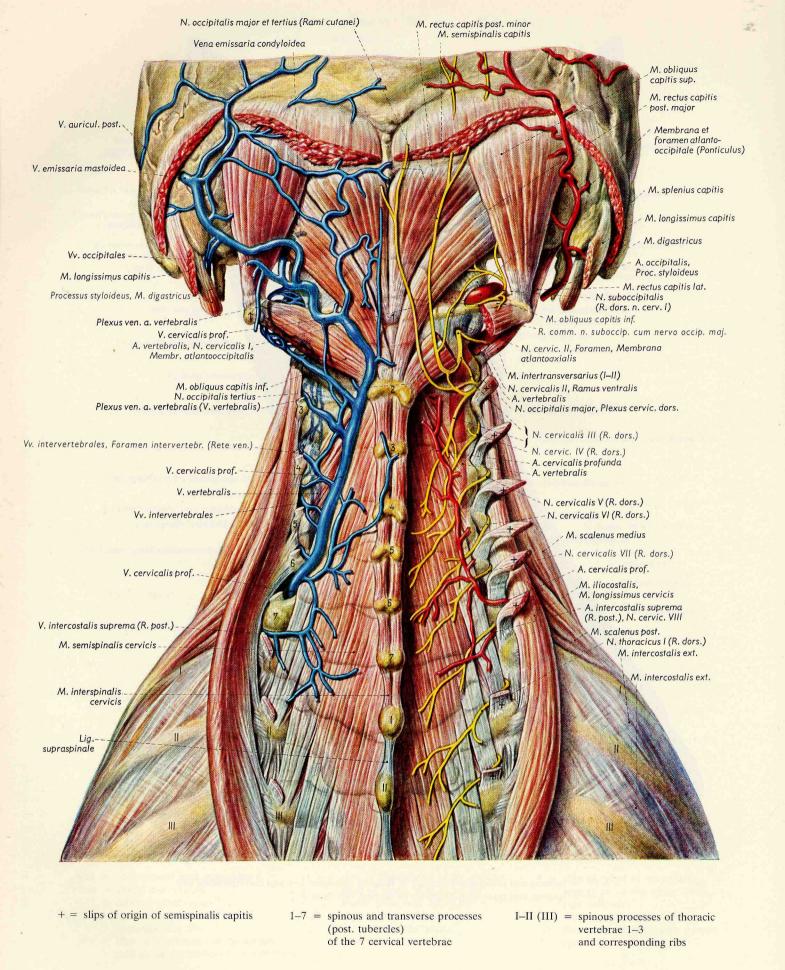
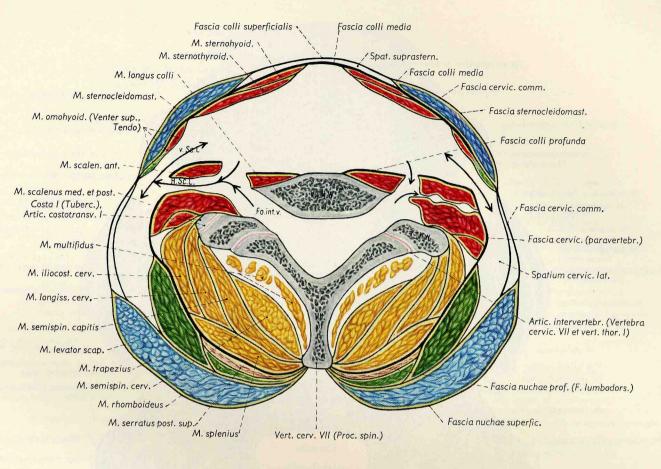


Fig. 246. The deep muscles, blood vessels, and nerves of the back of the neck. Arteries and nerves are shown on the right, nerves on the left. The shoulder girdle and associated musculature, the splenius, semispinalis capitis, and longissimus cervicis have been removed.



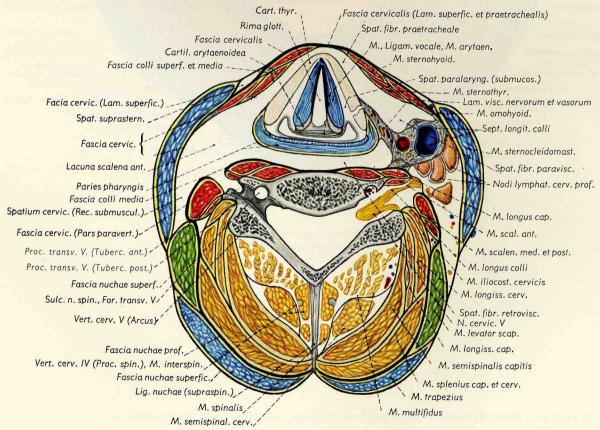


Fig. 247. (Top) Cross section through the neck at the level of the 7th cervical vertebra (bones, muscles, and fasciae).

Fig. 248. (Bottom) Cross section through the neck at the level of the 5th cervical vertebra (bones, muscles, and fasciae).

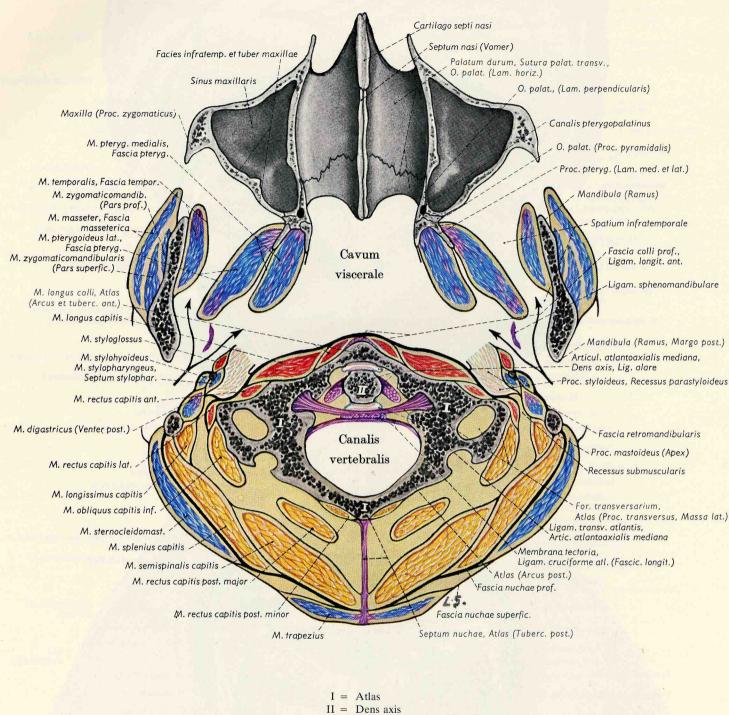


Fig. 249. Cross section through the neck at the level of the atlas, and through the facial skeleton immediately above the floor of the nasal cavity. Viewed from above, showing skeletal parts, muscles, ligaments, and fasciae. Arrows: entrance from the retromandibular fossa, in front of the styloid process, into the craniovertebral space, or rostrally into the infratemporal space.

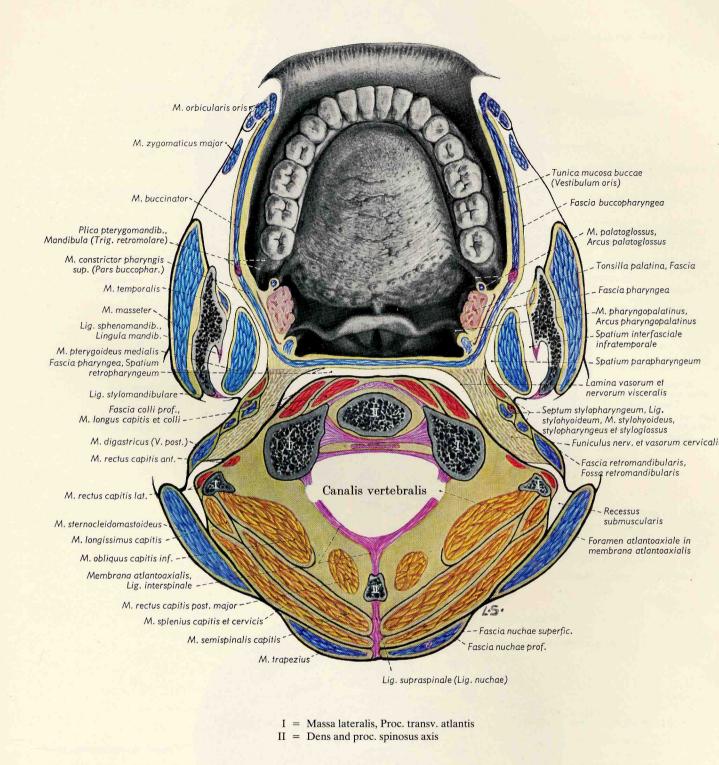


Fig. 250. Cross section through the head and neck region at the level of the dens of the axis, oropharynx, and the occlusal plane showing skeletal parts, muscles, ligaments, and fasciae. Paravisceral and retrovisceral compartments are white. The infratemporal (interfascial) fossa and the submuscular recess of the lateral fascial compartments of the neck are empty. Not included in the drawing are the buccal fat pad, the contents of the fascially enclosed retromandibular fossa (parotid gland), the structures in the illustrated neurovascular sheath (stylopharyngeal septum), and the neurovascular bundle that occupies the parastyloid recess.

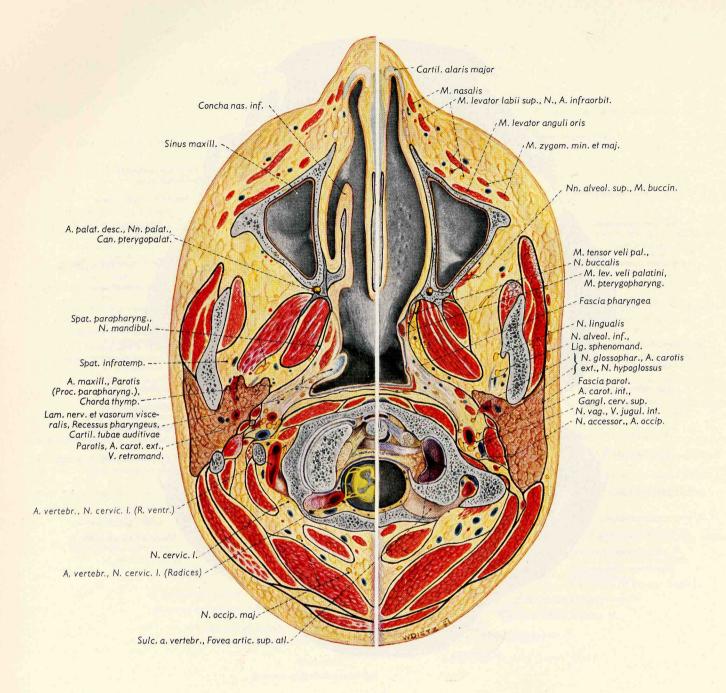


Fig. 251. Cross section through the head and neck region at the level of the nasopharynx (on the right side the cut was made somewhat more inferior). View of the floor of the nasal cavity and the maxillary sinus. Note the anterior extension of the parotid gland toward the parapharyngeal space.

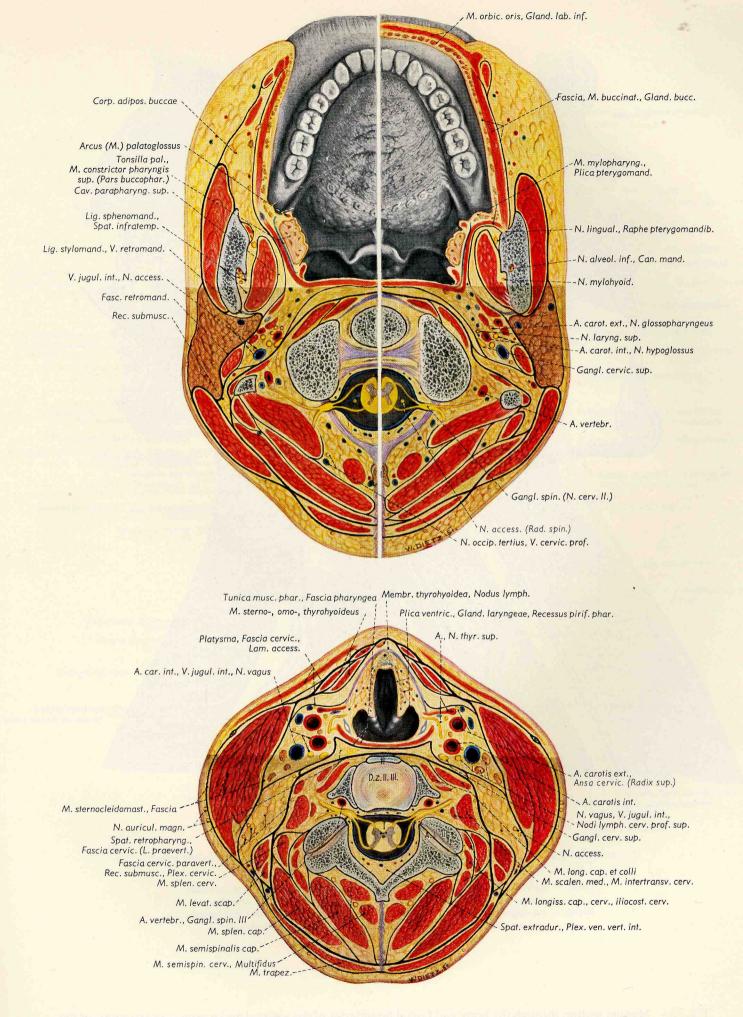


Fig. 252. (Top) Cross section through the head and neck region at the level of the oropharynx.

Fig. 253. (Bottom) Cross section of the neck through the glottis and the 2nd and 3rd cervical vertebrae.

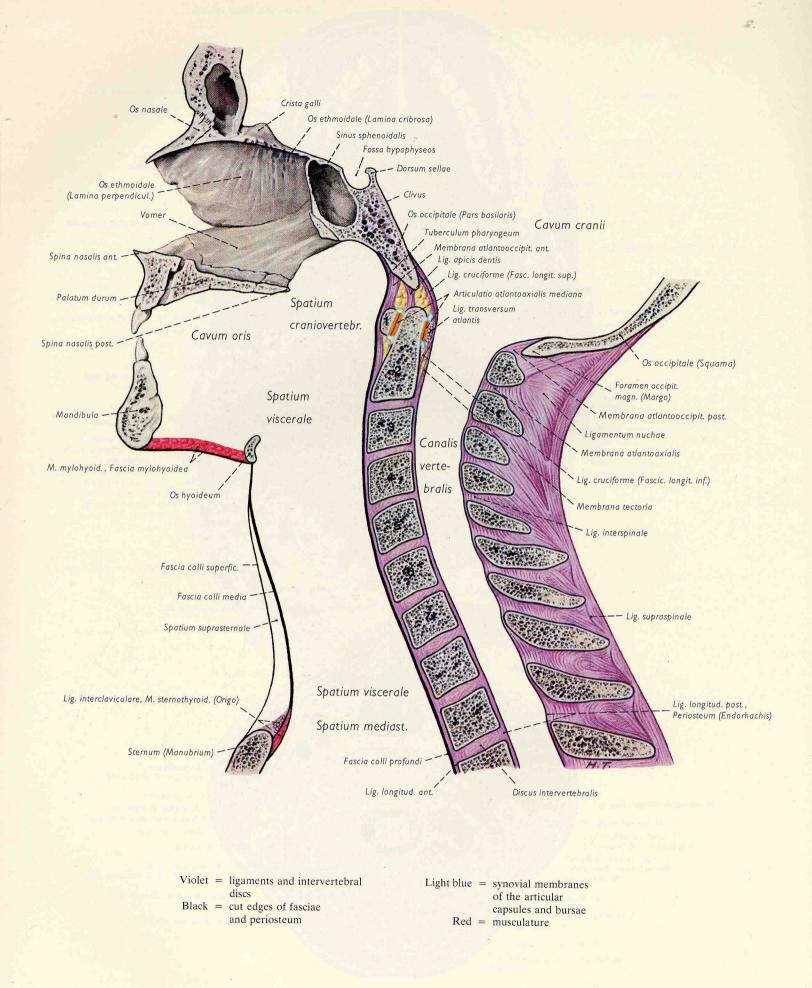


Fig. 254. Median section through the bony and fascial boundaries of the visceral and neural compartments of the neck. The visceral compartment of the neck, the adjoining craniovertebral space, the oral cavity above, the thoracic cavity below, and the vertebral canal are empty.

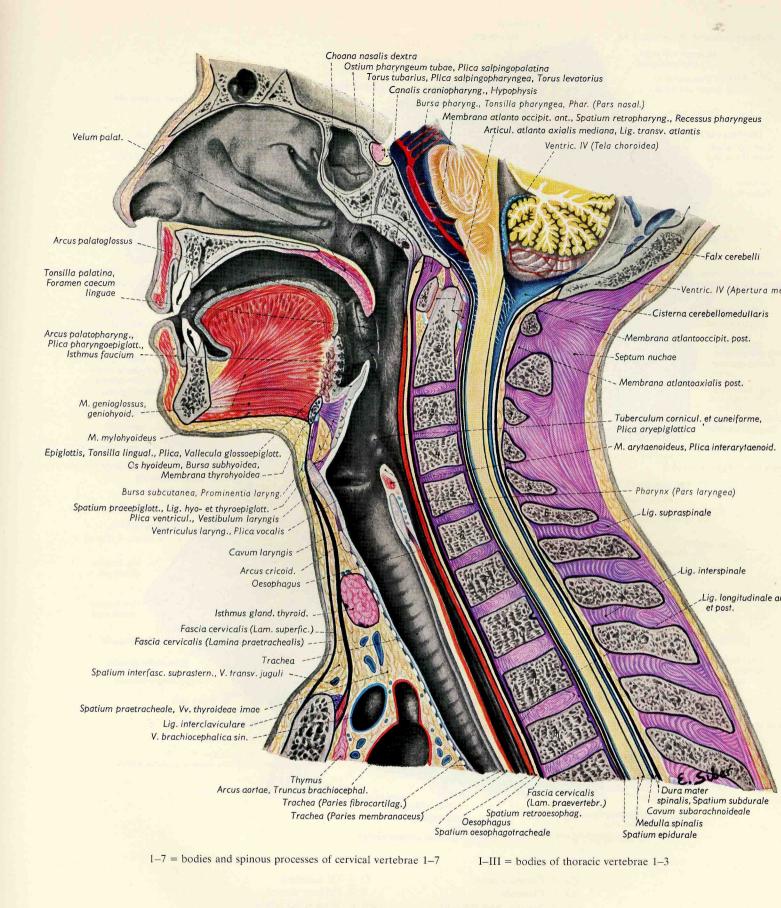


Fig. 255. Median section through the neck and adjoining head and thoracic regions with the contents of the fascial compartments (previsceral space, etc.); right half of the section.

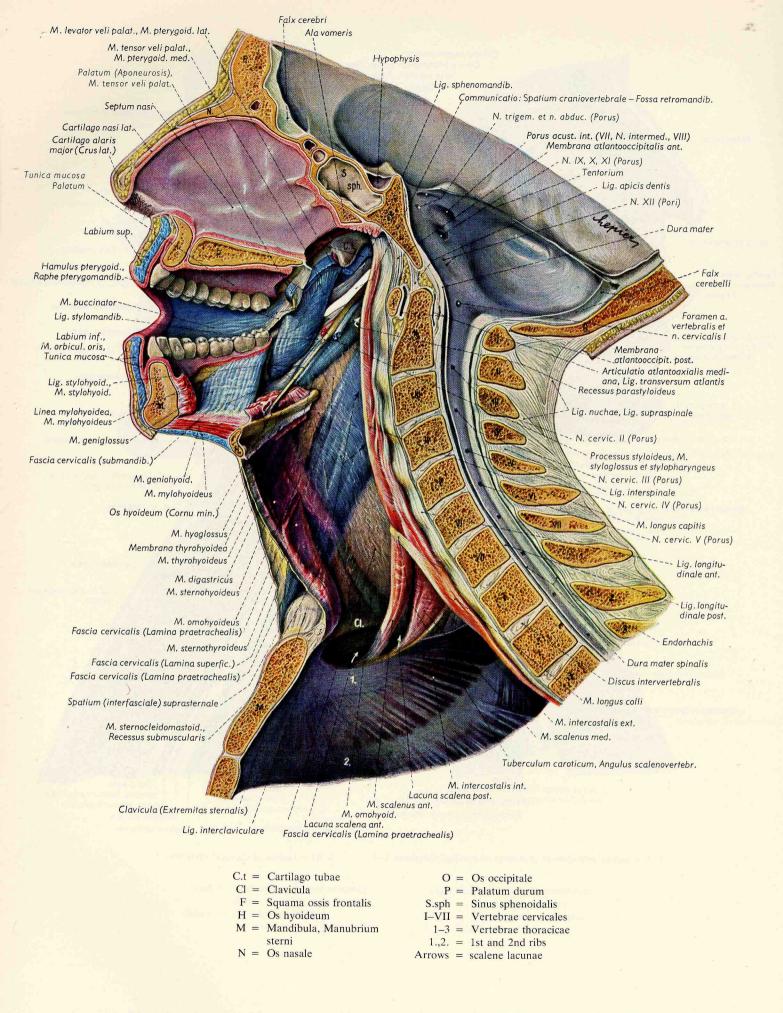


Fig. 256. Neck musculature of the right side seen from the medial aspect after removal of all viscera and neurovascular bundles.

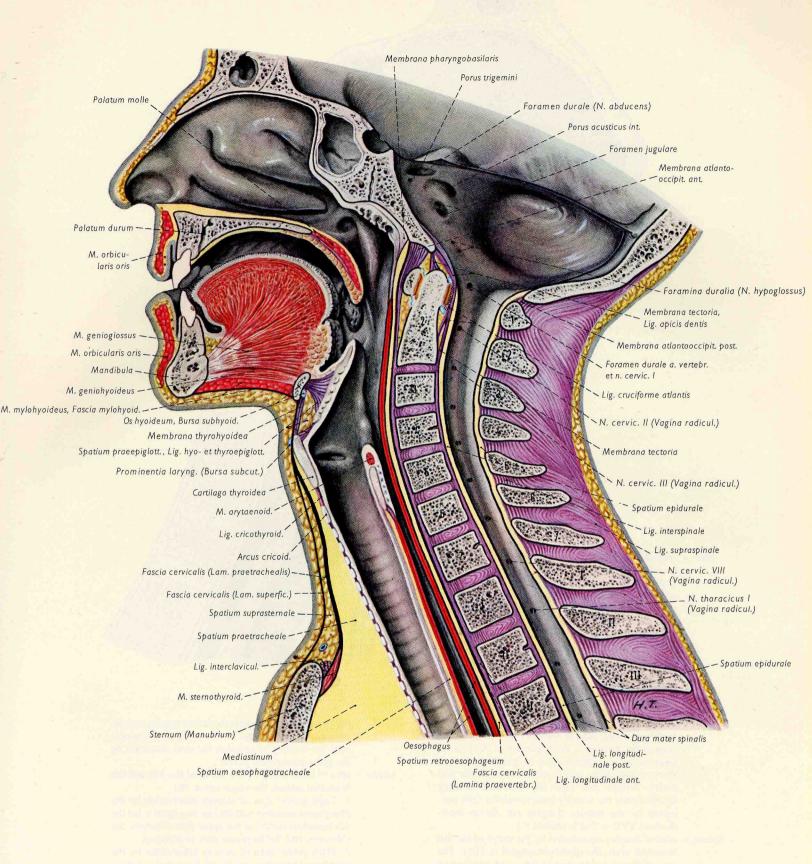
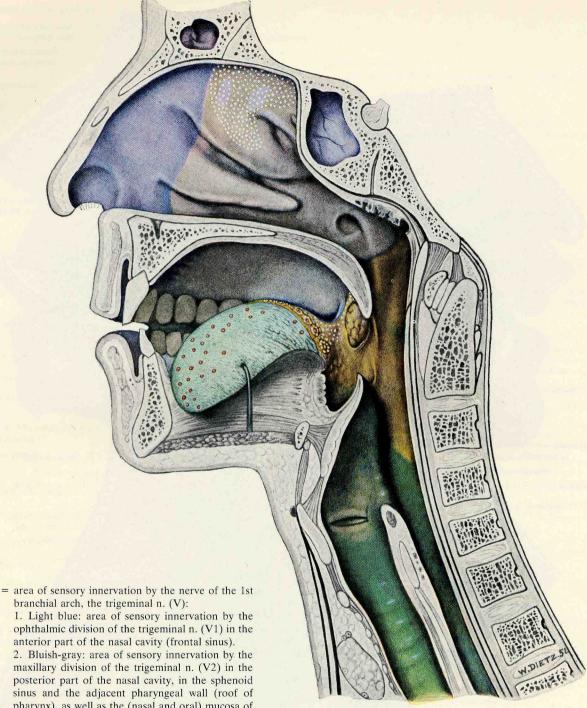


Fig. 257. Median section through the neck and adjoining head region.



Blue = area of sensory innervation by the nerve of the 1st

pharynx), as well as the (nasal and oral) mucosa of the palate and the vestibule of the oral cavity. The area of sensory innervation by the olfactory nerve (I, smell) is indicated by white dots on the lateral wall of the nasal cavity (olfactory region).

3. Bluish-green: area of sensory innervation by the mandibular division of the trigeminal n. (V3) on the mucosal surface of the body of the tongue in front of the terminal sulcus, and in the vestibule of the oral cavity. Within this field the red dots indicate schematically the sensory innervation for taste sensation by the chorda tympani (of nervus intermedius). (VII = 2nd branchial n.)

Brown = area of sensory innervation by the nerve of the 3rd branchial arch, the glossopharyngeal n. (IX): The area of sensory innervation by this nerve (pharyngeal and lingual branches) in the nasal and oral parts of the pharynx, partly also on the soft palate, the isthmus of the fauces, and the root of the tongue. The white dots behind the terminal sulcus in the region of

the circumvallate papillae, the foliate region, and the adjacent mucosa of the isthmus indicate schematically the sensory innervation for taste sensation by the glossopharyngeal nerve.

Green = area of innervation by the nerve of the 4th and 6th branchial arches, the vagus nerve (X):

> 1. Light green: area of sensory innervation by the pharyngeal branches and the sup. laryngeal n. (of the 4th branchial nerve) in the upper part of larynx, the vallecula, and the laryngeal part of pharynx.

> 2. Dark green: area of sensory innervation by the pharyngeal branches and the inf. laryngeal n. (of the 6th branchial nerve) in the laryngeal part of pharynx, the esophagus, the lower part of larynx, and the trachea. These 2 fields of innervation overlap in the area of the vocal cords.

Fig. 258. The sensory innervation of the mucosa of the upper gastrointestinal and respiratory tracts in the head and neck shown in a median section (right half of section).

Topography of the Neck Regions

Fig. 259. Superficial layers of the neck. The platysma and subcutaneous structures in the anterior and posterior triangles.

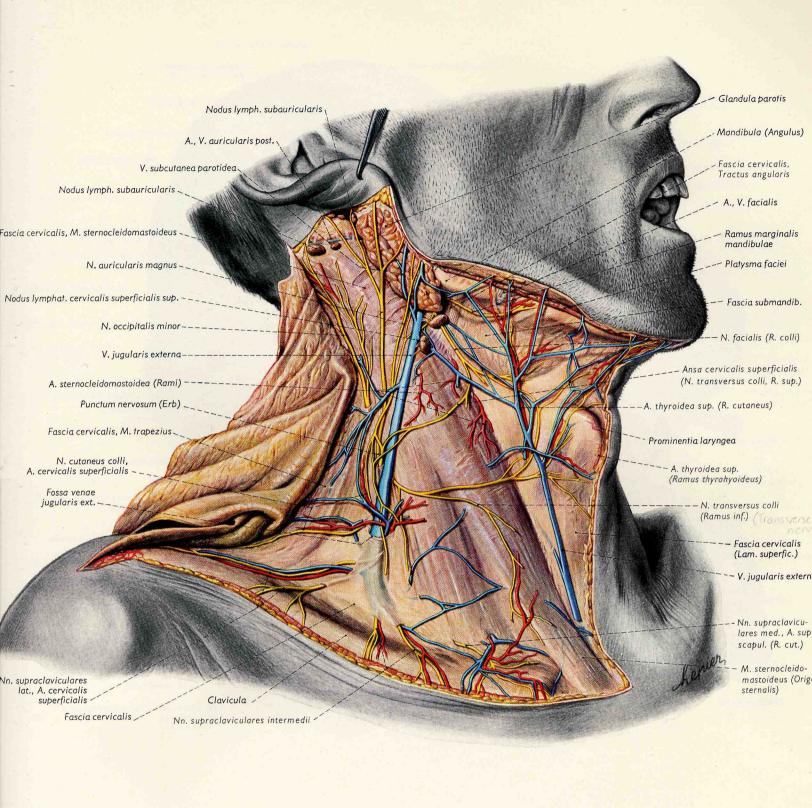


Fig. 260. Superficial layers of the neck after removal of the platysma. Dissection of subcutaneous structures on the ventrolateral aspect of the cervical fascia as well as the cervical pole of the parotid gland in the retromandibular fossa.

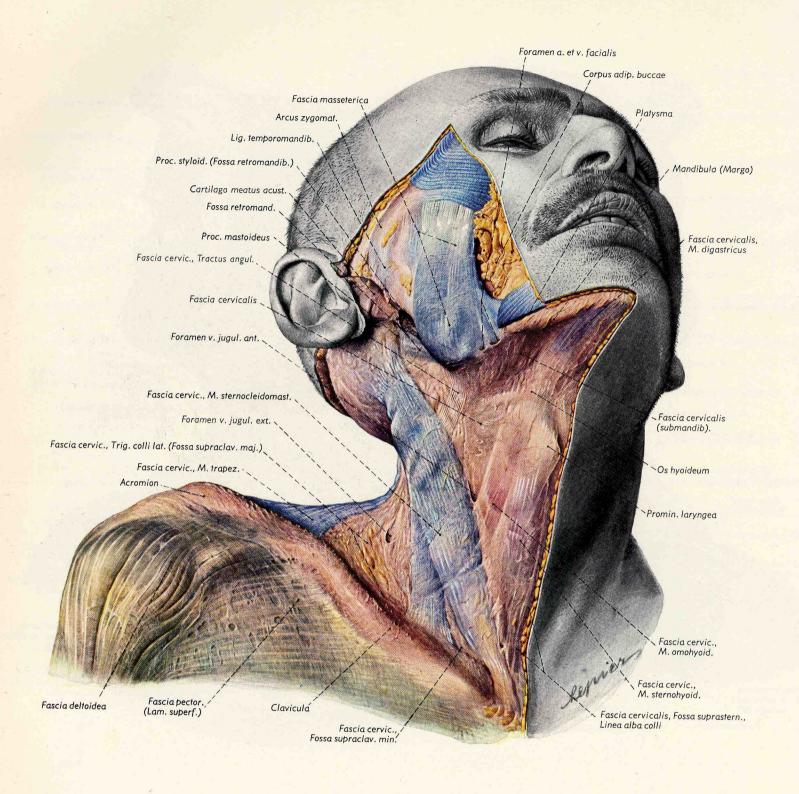


Fig. 261. The superficial layer of the cervical fascia. The skin, subcutaneous tissue, and platysma have been removed from the face and neck on the right side.

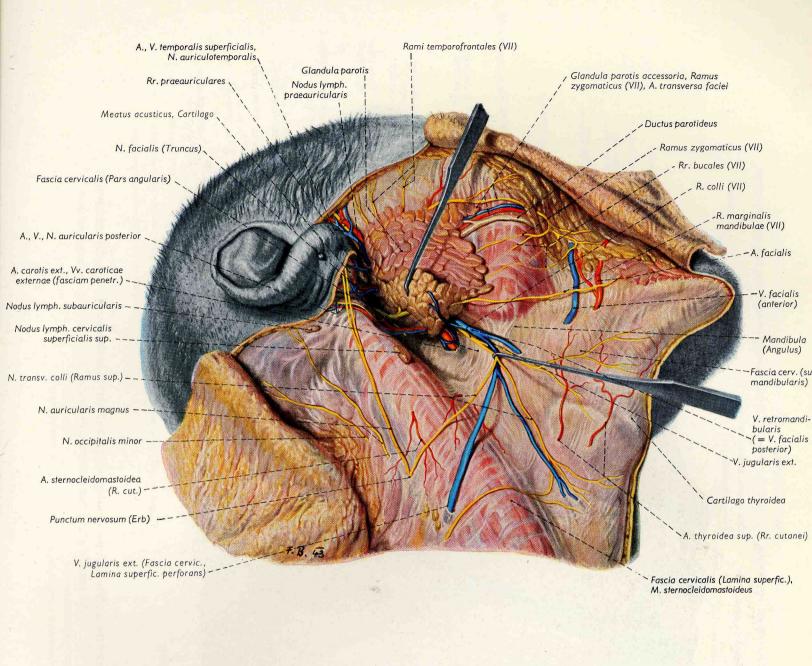


Fig. 262. The parotid gland, the retromandibular fossa, the submandibular and carotid triangles after removal of the skin and platysma. The cutaneous branches of the cervical plexus emerge at Erb's point.

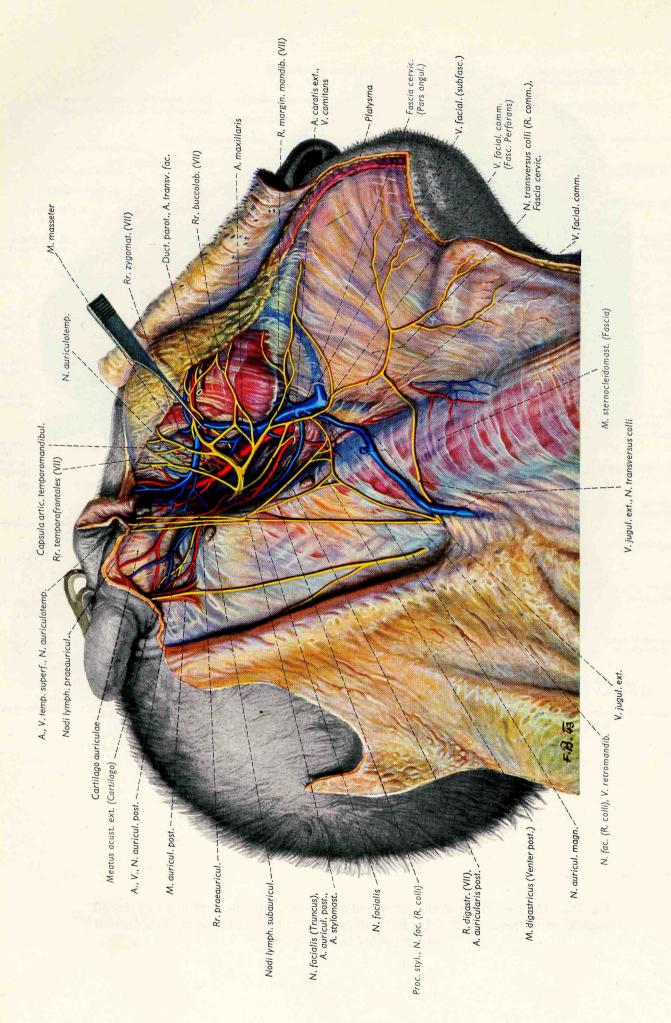


Fig. 263. Dissection of the retromandibular fossa showing vessels and nerves in the parotid bed after removal of the parotid gland but retaining its fascia.

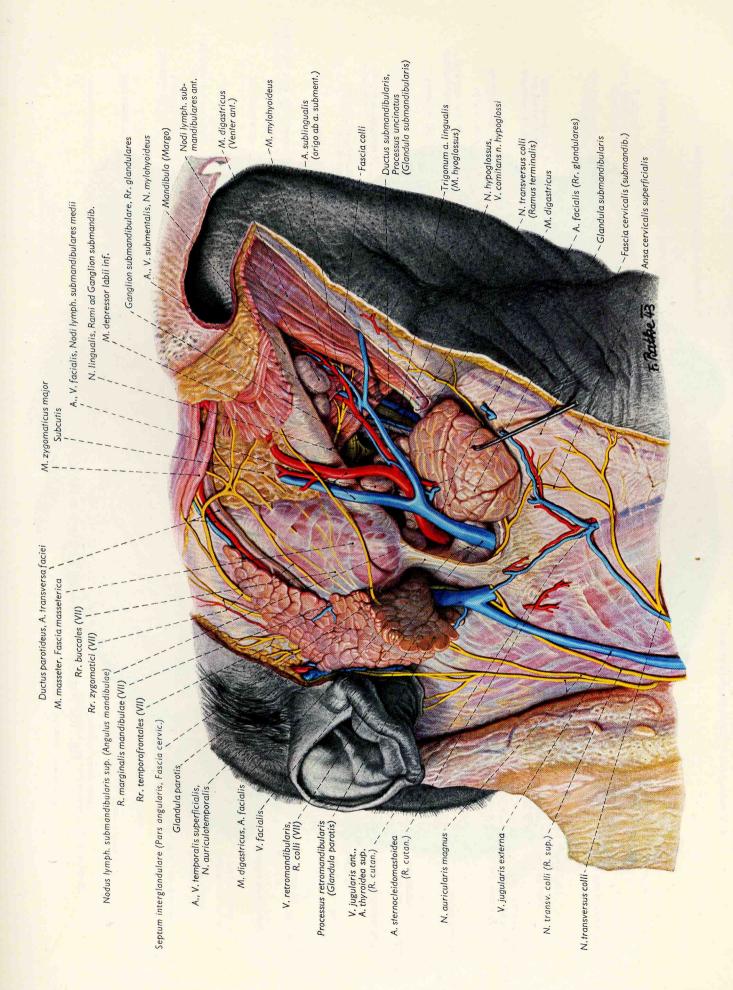


Fig. 264. Regional dissection of the submandibular triangle showing the submandibular gland and the subfascial vessels and nerves.

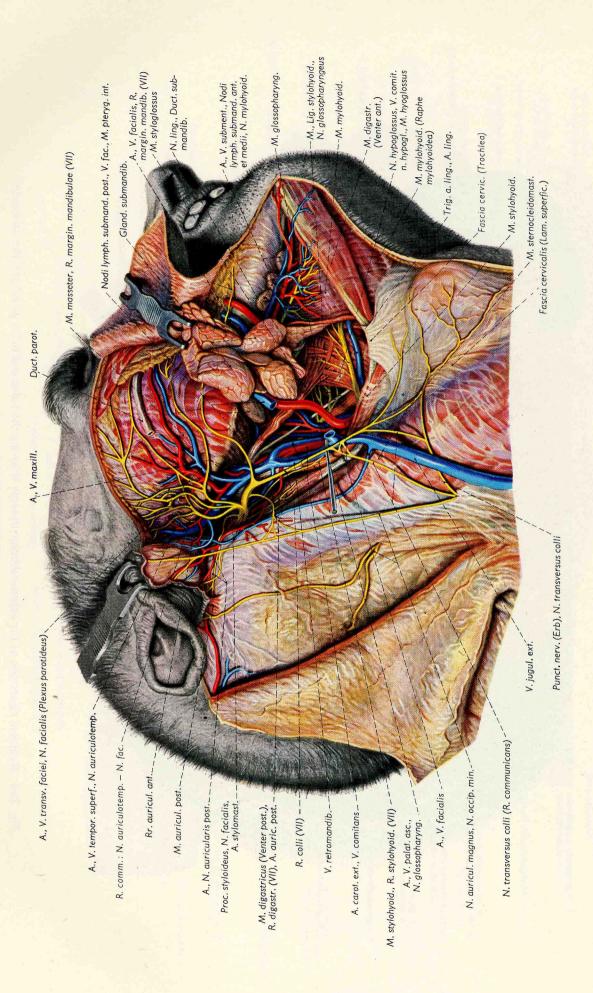


Fig. 265. Regional dissection of the submandibular triangle and the submandibular fossa.

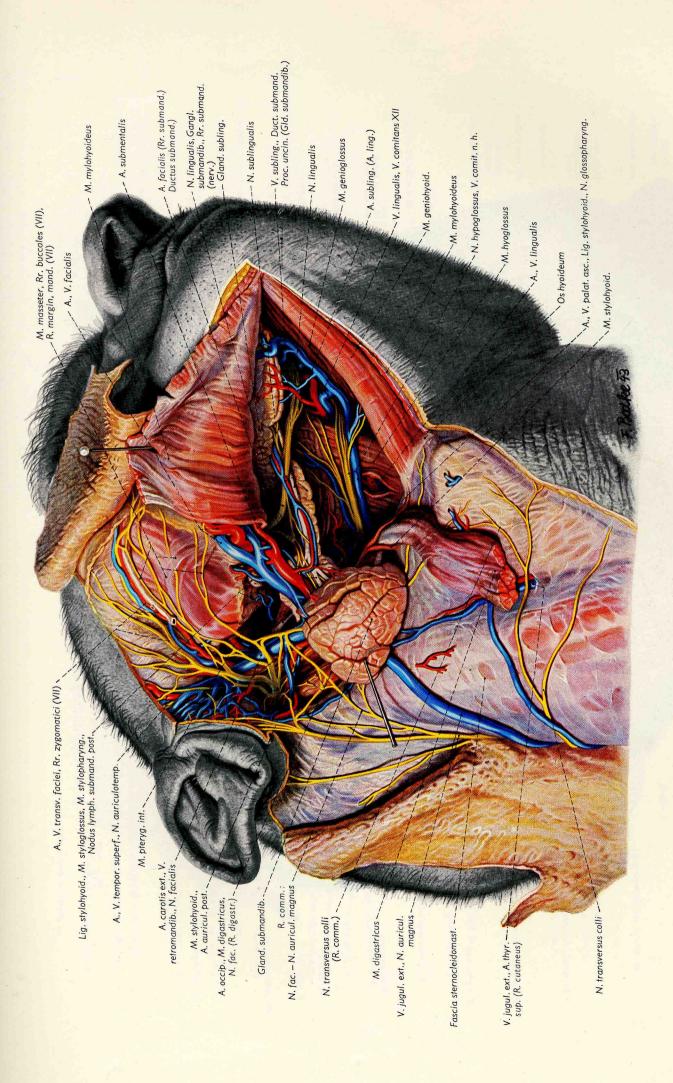


Fig. 266. Regional dissection of the deep aspects of the submandibular triangle and the retromandibular fossa, showing the paralingual structures in the floor of the mouth. The digastric muscle has been divided; the mylohyoid muscle has been incised along its raphe and reflected upward. Note the lingual trigone with the exposed lingual artery.

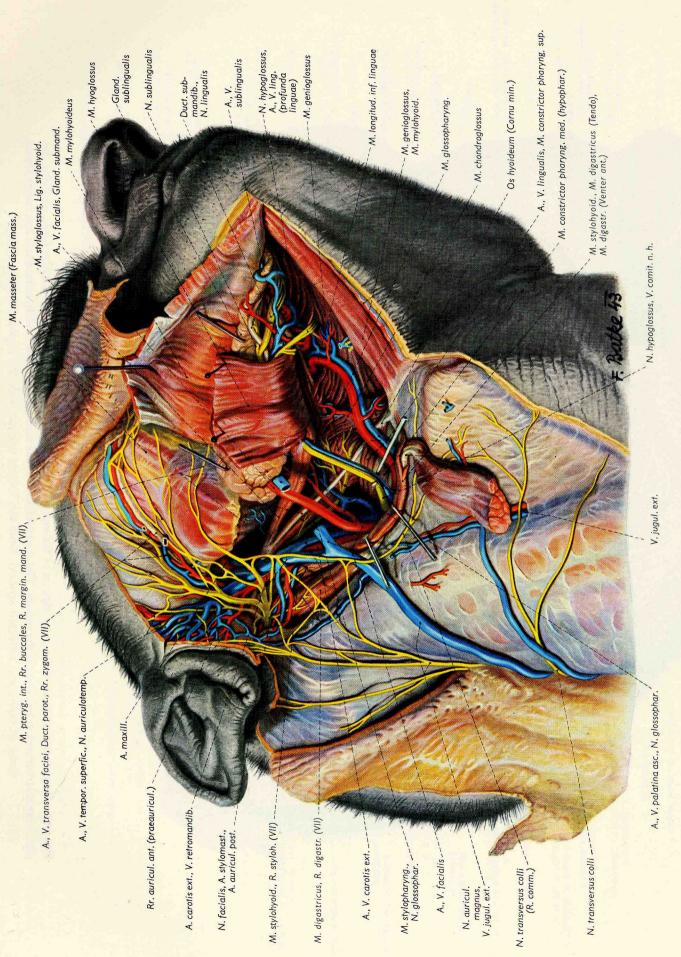


Fig. 267. Regional dissection of submandibular triangle and retromandibular fossa showing paralingual structures after dividing and retracting the mylohyoid and hyoglossus muscles.

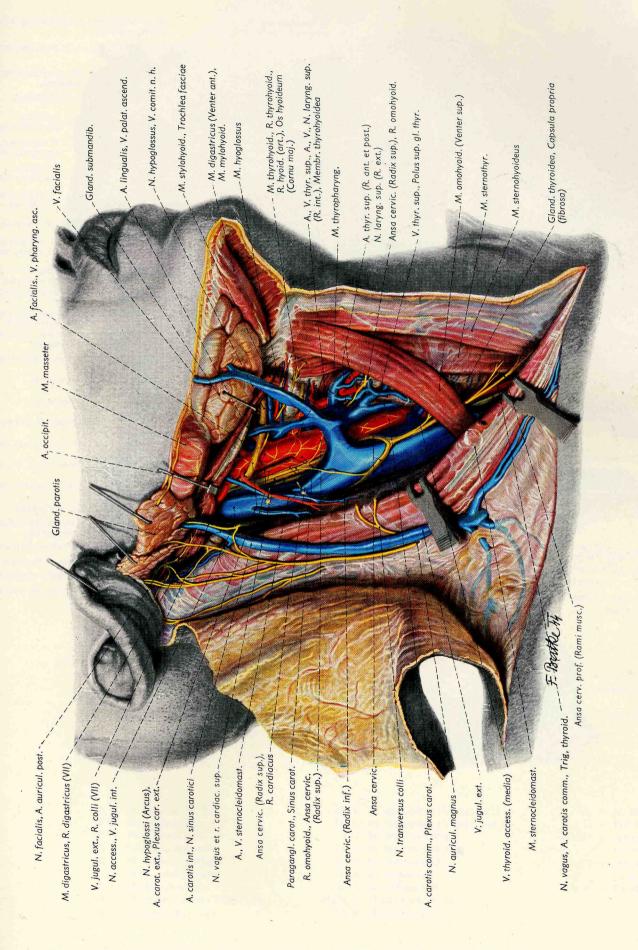


Fig. 268. Regional dissection of structures in the carotid triangle. Exposure of subfascial structures in the carotid triangle and in the thyroid triangle (between the omohyoid, the sternothyroid, and the sternocleidomastoid muscles).

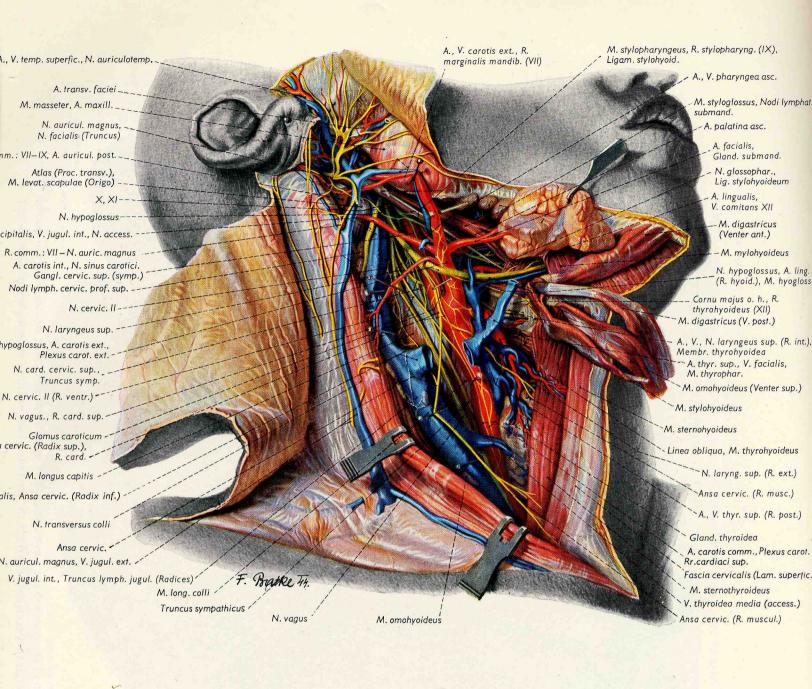


Fig. 269. Deep aspect of the anterior cervical triangle. Regional dissection of vessels and nerves in the carotid and submandibular triangles, as well as the retromandibular fossa.

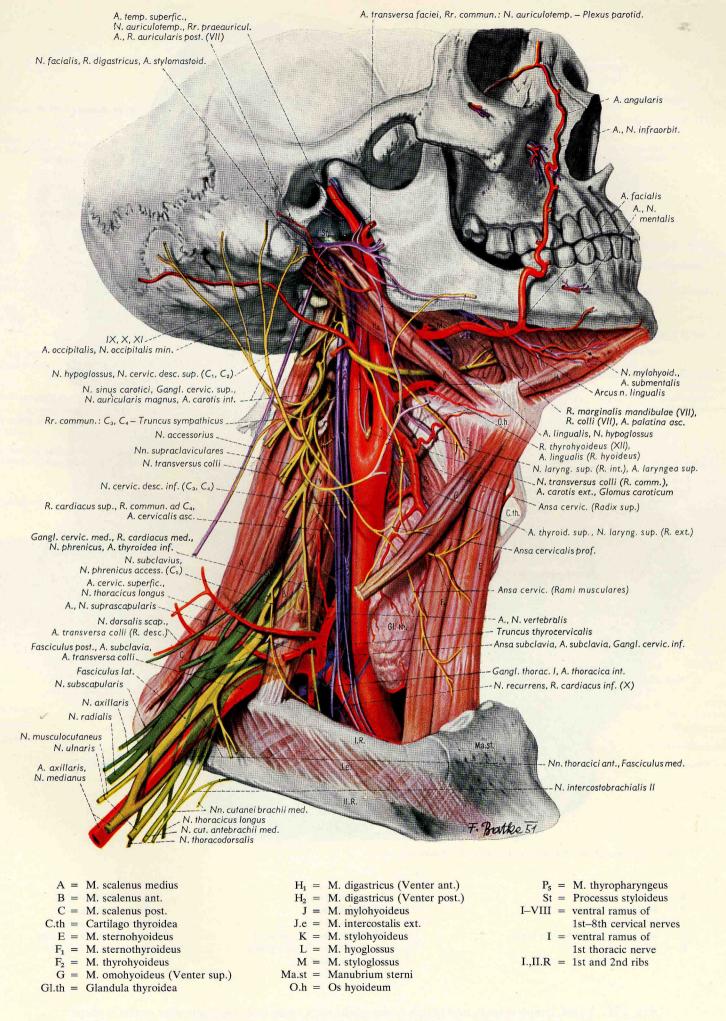


Fig. 270. Arteries and nerves of the neck, from the right side. The shoulder girdle, the sternocleidomastoid, and the posterior neck muscles have been removed.

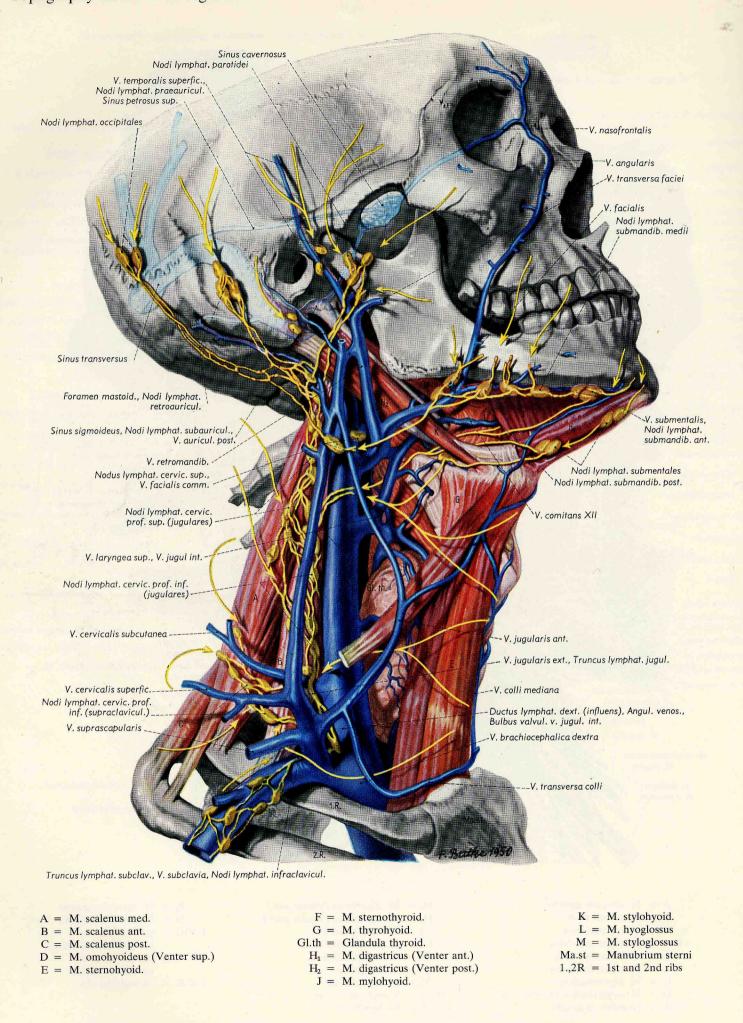


Fig. 271. Veins, lymph vessels, and lymph nodes of the neck, seen from the right after removal of the shoulder girdle, the sternocleidomastoid, and the posterior neck muscles. The direction of lymph flow is schematically indicated by yellow arrows.

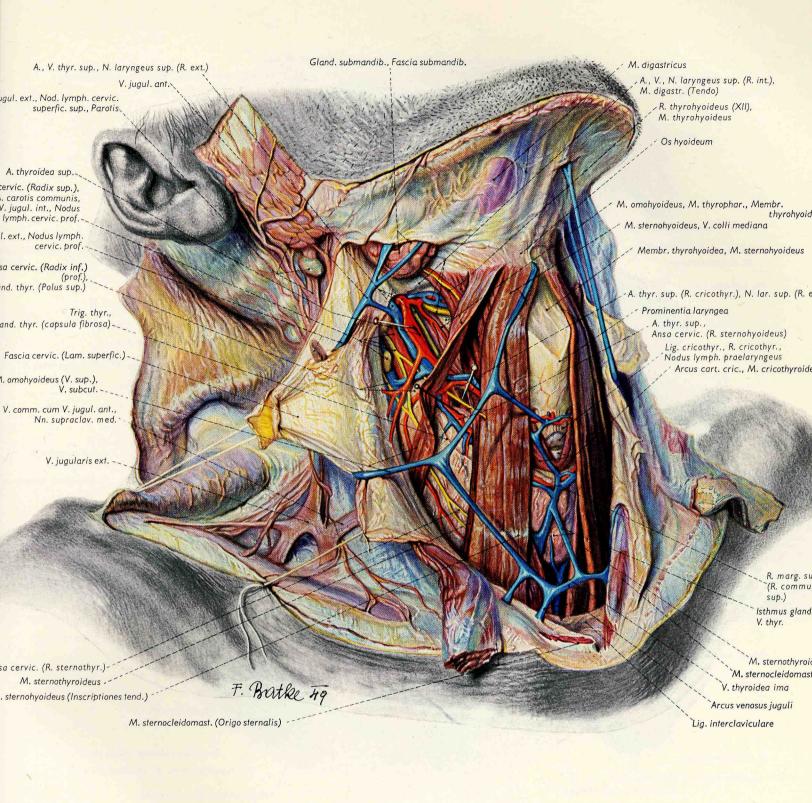


Fig. 272. Blood vesels, nerves, and muscles in the midline of the neck and in the carotid triangle (superficial). Laryngeal cartilages and thyroid gland.

Fig. 273. Sternocleidomastoid region. Exposure of the infrahyoid area of the anterior neck region showing both laminae of the cervical fascia.

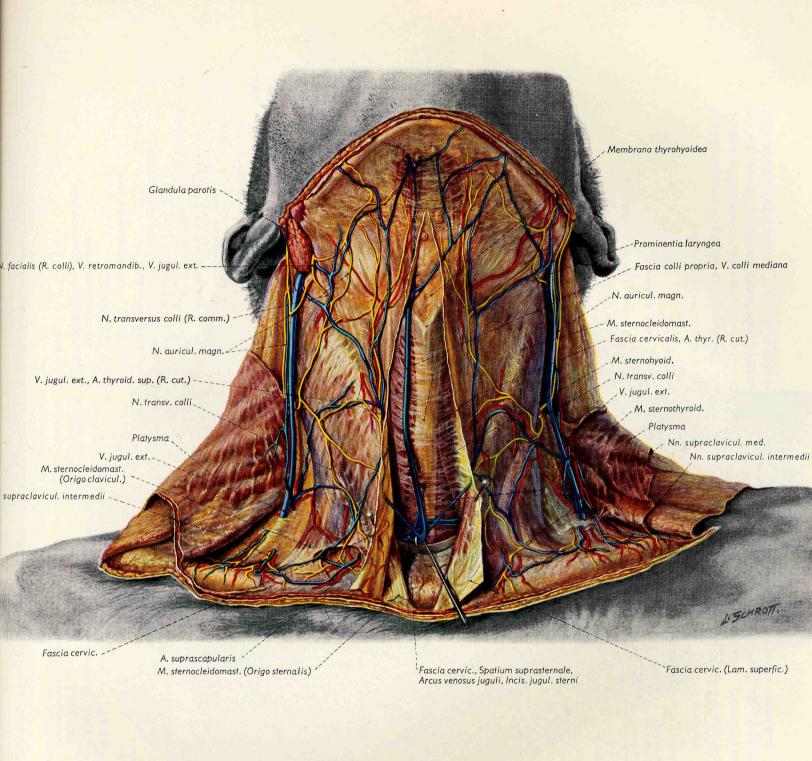


Fig. 274. Superficial dissection of the ventrolateral aspects of the neck and the suprasternal fossa.

The suprasternal space (interfascial) has been opened.

I = ventral ramus of 1st thoracic nerve 4th-8th cervical nerves 4-8 = ventral rami of M.h.th = Membrana thyrohyoidea I.,II. = 1st and 2nd rib C.cr = Cartilago cricoidea C.th = Cartilago thyroidea L.c = Lig. conicum Fig. 275. Topography of the superior thoracic aperture, the cupula of the pleura, and the scalenovertebral triangle.

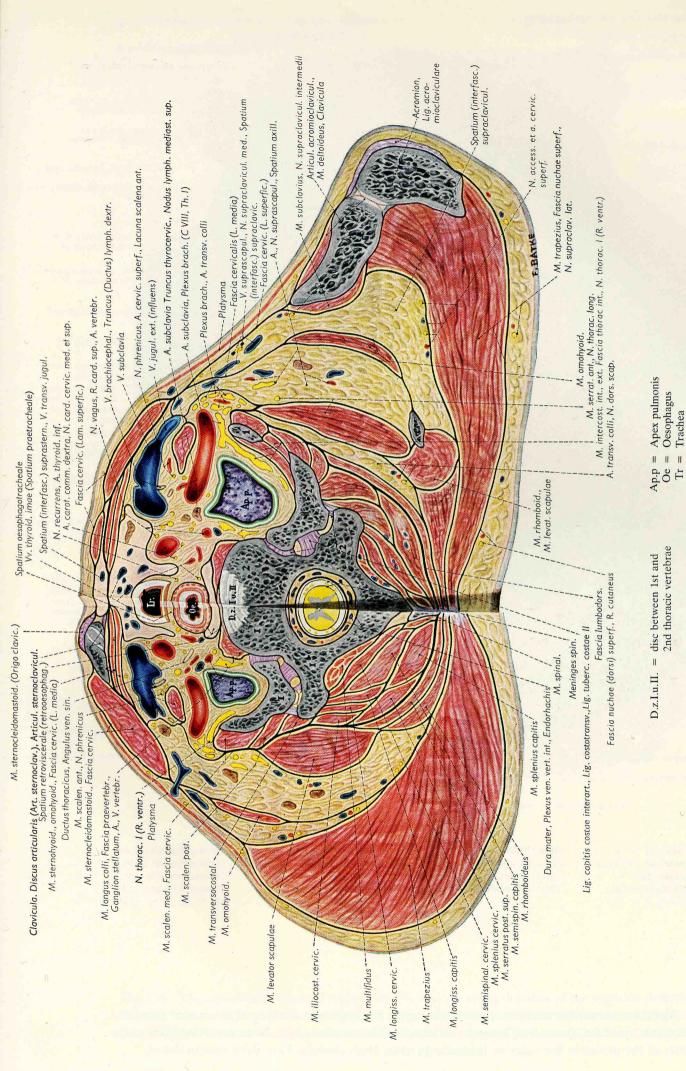


Fig. 276. Cross section at the level of the superior thoracic aperture and the cupula of the pleura. The planes of sectioning on the right and left sides of the midline are inclined differently: on the right side, the cut passes through the 2nd thoracic vertrebra, the superior angle of the scapula, and the acromioclavicular joint; on the left, through the 1st thoracic vertebra, and the sternoclavicular joint (in front). Therefore, the section of the right side is deeper posteriorly and higher anteriorly when compared with the left side. The cut edge of the cervical fascia is indicated by thick lines (sections viewed from above).

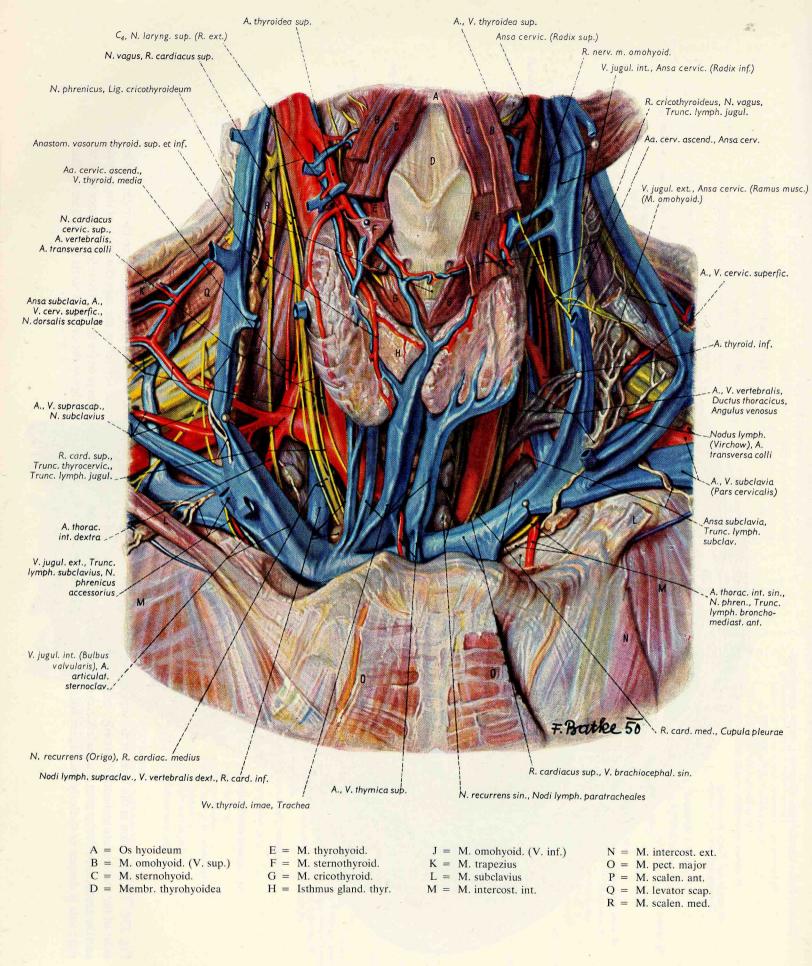


Fig. 277. Blood vessels and nerves in the lower neck region, particularly in the area of the thyroid gland, the superior thoracic aperture, the scalene lacunae, and the so-called venous angle. Note the topography of the cupula of the pleura in the superior thoracic aperture. Both clavicles have been disarticulated.

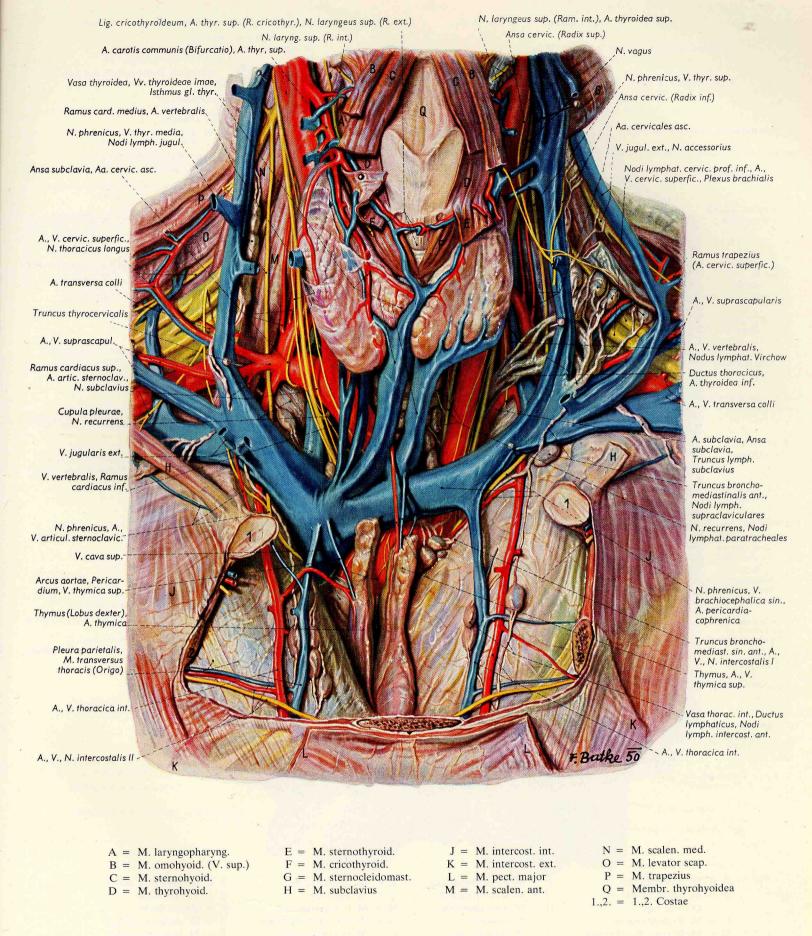


Fig. 278. The sternocleidomastoid region, vessels, and nerves in the area of the superior thoracic aperture. Dissection of the thyroid gland, the cupula of the pleura, the large vessels, and nerves, and demonstration of continuity with structures in the mediastinum by partial resection of the 1st and 2nd ribs as well as the manubrium of sternum.

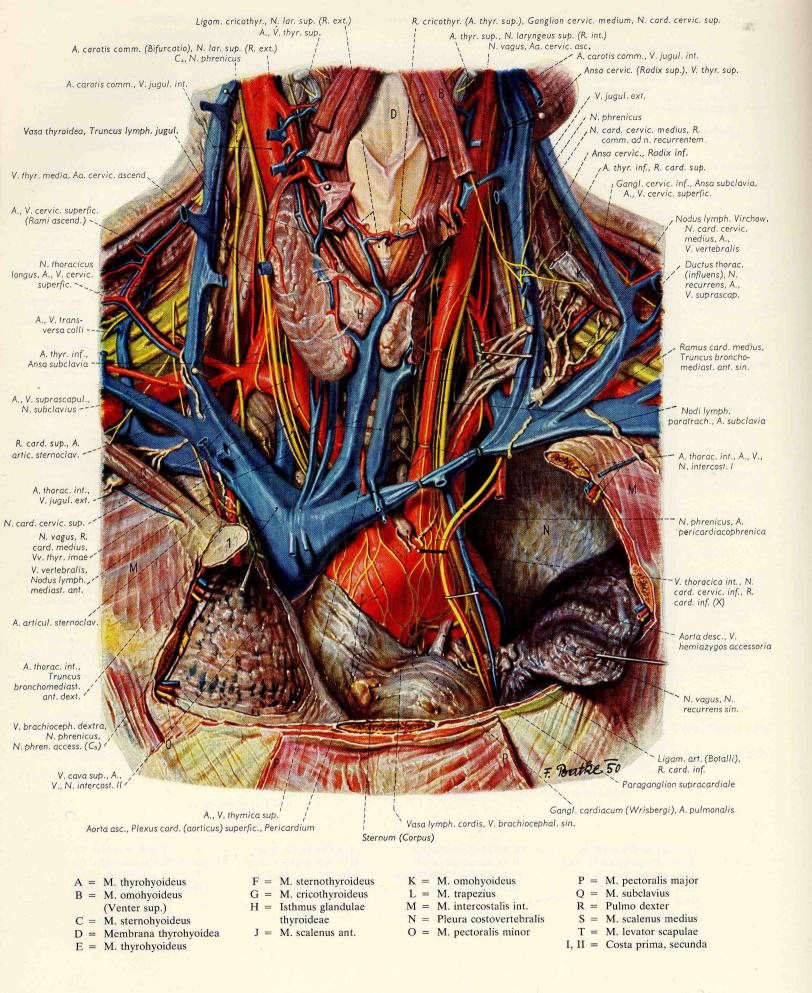


Fig. 279. Topography of the superior thoracic aperture and the deep neck region after removal of the manubrium of sternum, and resection of the sternal ends of the 1st and 2nd ribs. The arch of the aorta.

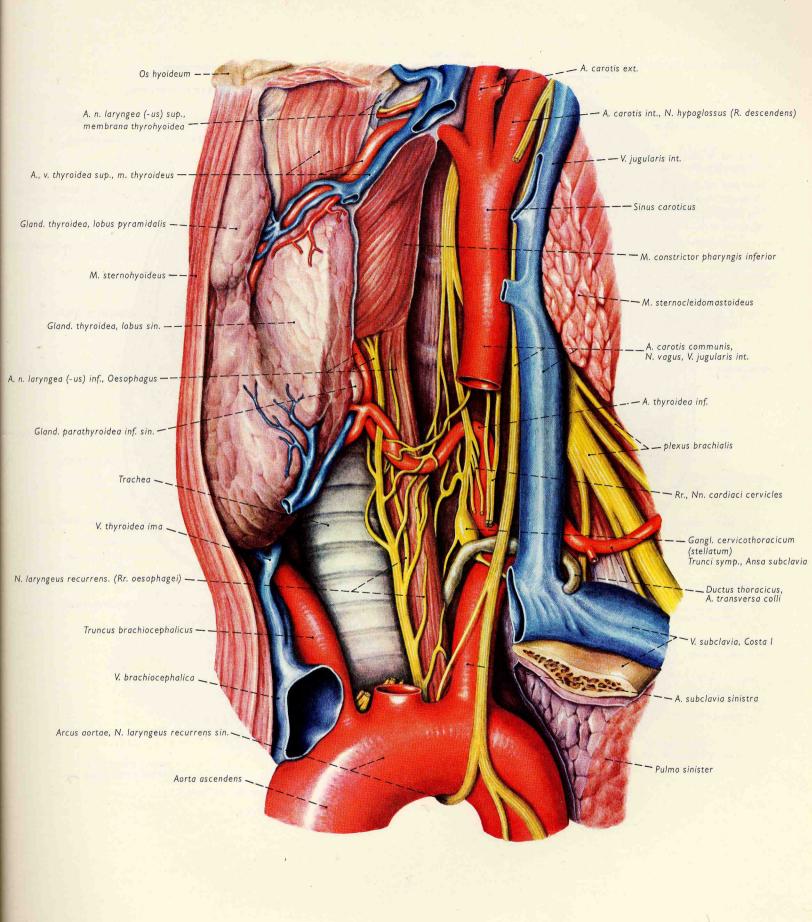


Fig. 280. Neurovascular structures of the deep neck region; opening of the thoracic duct into the venous angle (angulus venosus). Anterolateral view.

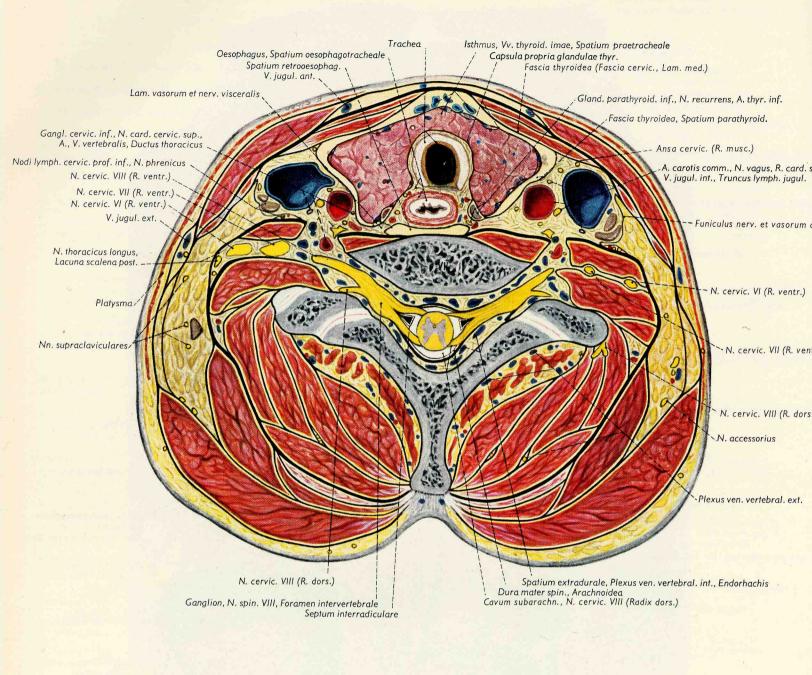


Fig. 281. Transverse section through the neck at the level of the isthmus of the thyroid gland and the 7th cervical vertebra. Illustration of the viscera, the cervical neurovascular bundles, and the perivisceral compartments in cross section. The cut edges of the fasciae are black.

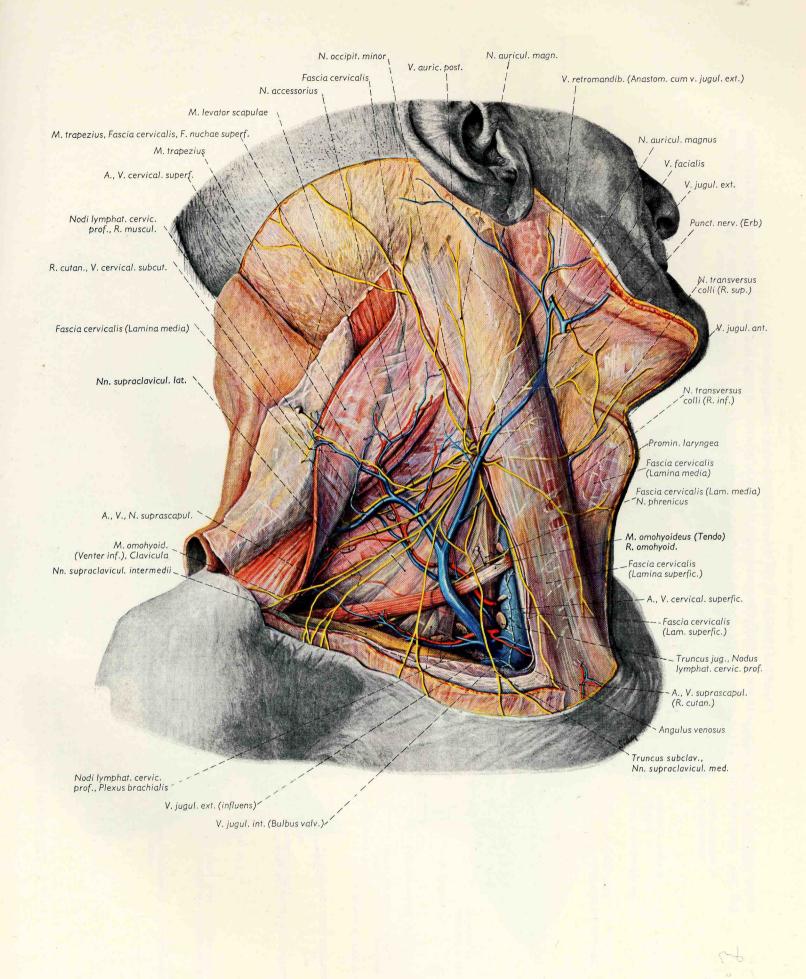
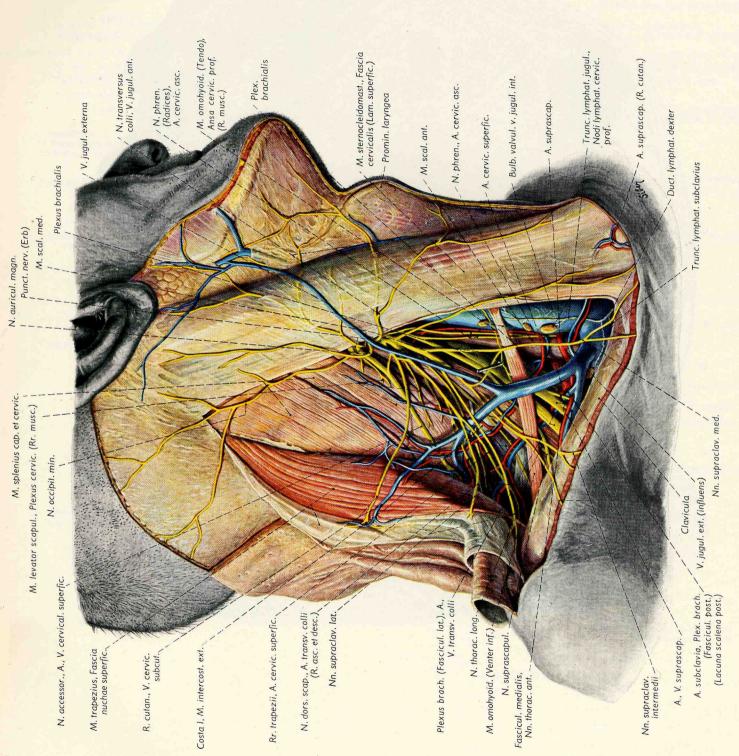


Fig. 282. Blood vessels and nerves in the lateral neck region, particularly in the supraclavicular area.

The lateral cervical fascial compartment has been opened.



The brachial plexus and subclavian artery are seen in the space between the anterior and middle scalenes. Fig. 283. Blood vessels, nerves, and muscles in the posterior triangle of the neck.

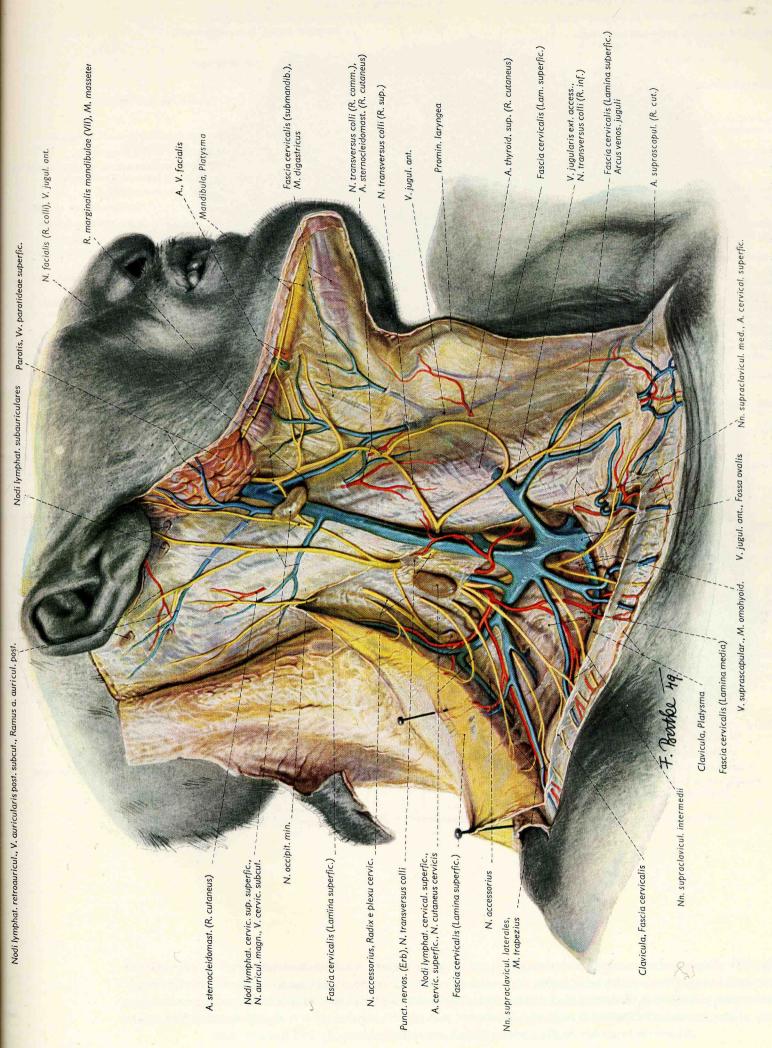


Fig. 284. Ventrolateral aspect of the neck after removal of skin and platysma showing nerves and blood vessels in the supraclavicular region. The fascial compartment between the middle and superficial laminae of the cervical fascia has been opened by reflecting the latter.

Fig. 285. Deep structures on the lateral aspect of the neck. Dissection of the sternocleidomastoid region and the infrahyoid area of the anterior neck region. Demonstration of the continuity of structures in the sternocleidomastoid region with those in the lateral neck region, and in the carotid and retromandibular fossae, after partial resection of the sternocleidomastoid muscle, the infrahyoid and posterior group of suprahyoid muscles. The upper cutaneous branches of the cervical plexus are reflected laterally and fixed by pins.

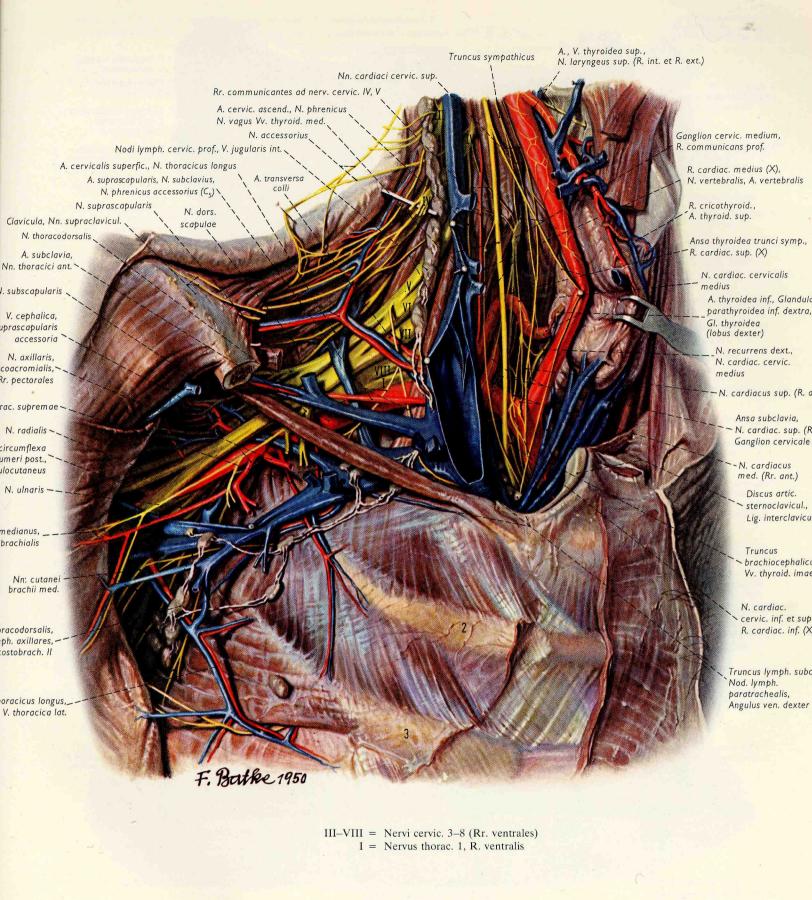


Fig. 286. Vessels and nerves in the lower neck region, in the scalenovertebral trigone, in the superior thoracic aperture, in the posterior triangle, and in the axilla. The right lobe of the thyroid gland has been reflected to the left, and the common carotid a. and int. jugular v. have been separated from each other so that the deep structures of the scalenovertebral triangle may be seen: inferior thyroid a., vertebral a. (origin). The bulb of the int. jugular v. has been opened in order to show the valves.

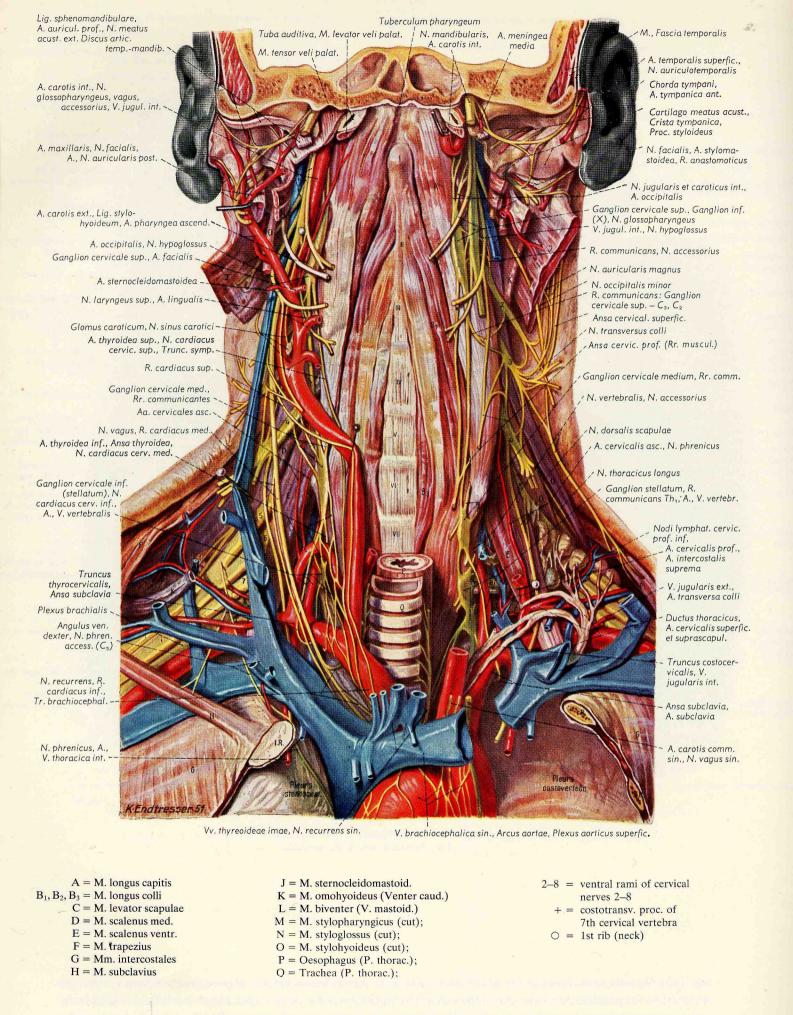
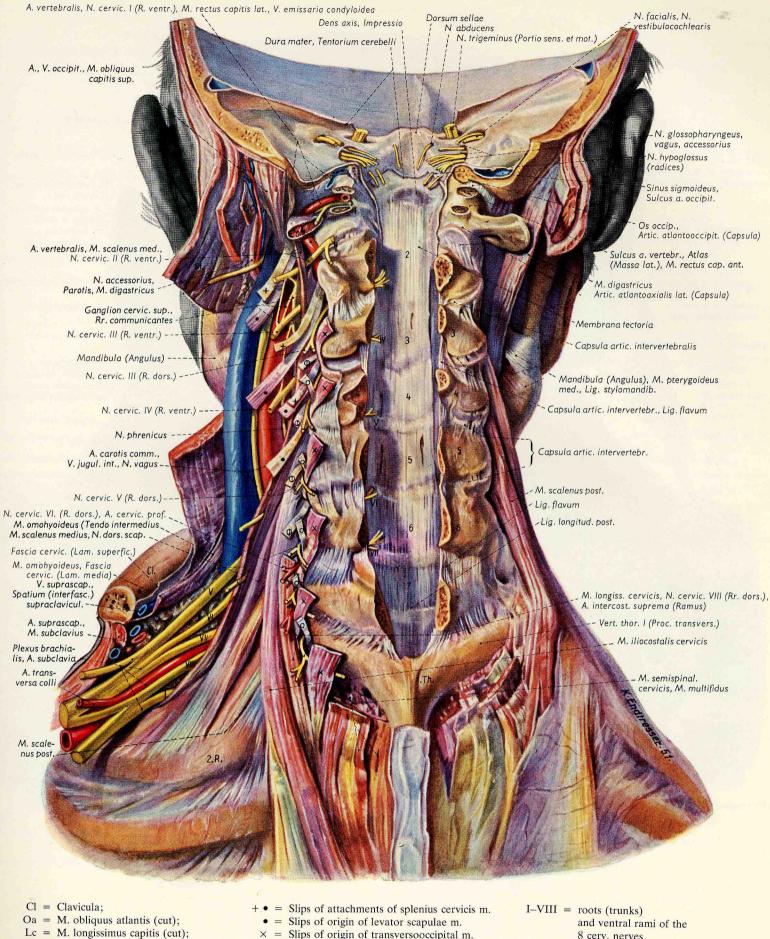


Fig. 287. Cervical and axillary neurovascular bundle from front. Blood vessels and nerves in the region of the superior thoracic aperture.



St = M. sternocleidomastoideus (cut);

Sc = M. splenius capitis (cut);

× = Slips of origin of transversooccipital m. Slips of origin of longissimus capitis m.

Slips of attachments of longissimus cervicis m.

8 cerv. nerves

Fig. 289. Superficial layer of the posterior neck and occipital regions. Left: subcutaneous structures and superficial lamina of the cervical fascia. Right: superficial muscles and overlying vessels and nerves, particularly in the occipital trigone.

Fig. 290. Continued dissection of posterior neck region: exposure of the intrinsic muscles of the posterior neck and the overlying vessels and nerves after reflection of the superficial muscles (the trapezius, rhomboid, and post, sup, serratus muscles), particularly the splenius muscle. On the right side: exposure of the semispinalis capitis, longissimus capitis and cervicis, and the iliocostalis cervicis muscles after reflection of the splenius muscle.

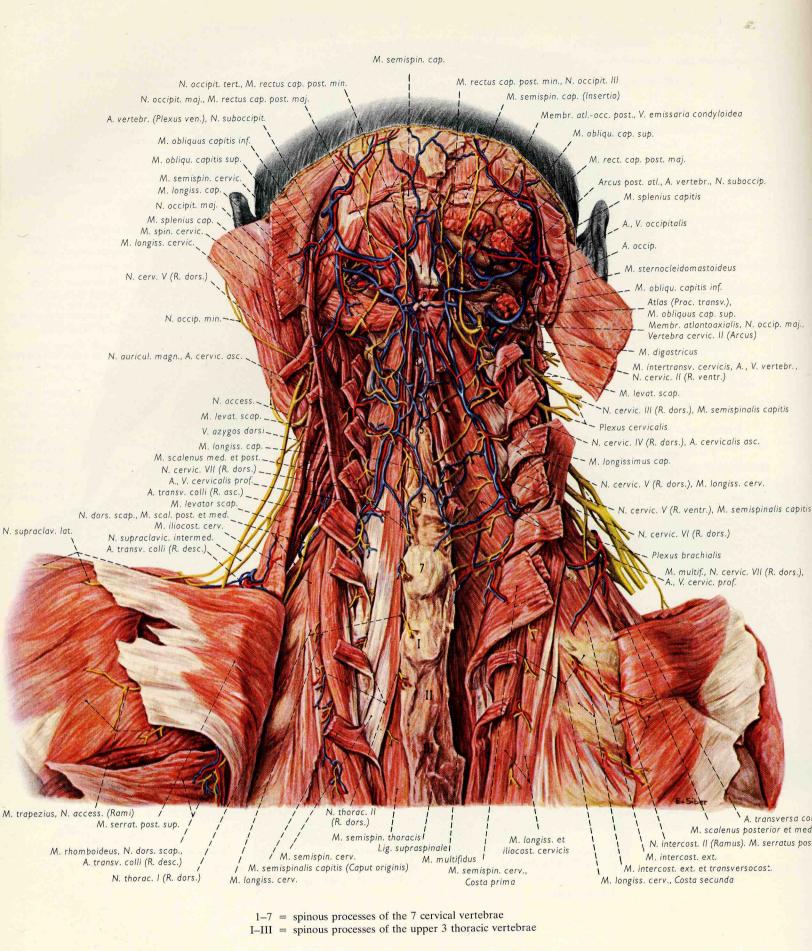


Fig. 291. Deep posterior neck region with blood vessels and nerves. Dissection of the deep (intrinsic) muscle layers down to the skeletal level. Left: exposure of the longissimus capitis and cervicis muscles, and the iliocostalis cervicis as well as the semispinalis cervicis, and the small muscles of the suboccipital triangle, after reflection of the semispinalis capitis. Right: dissection of the deepest layer, the multifidus muscles.

The Vertebral Canal and the Spinal Cord

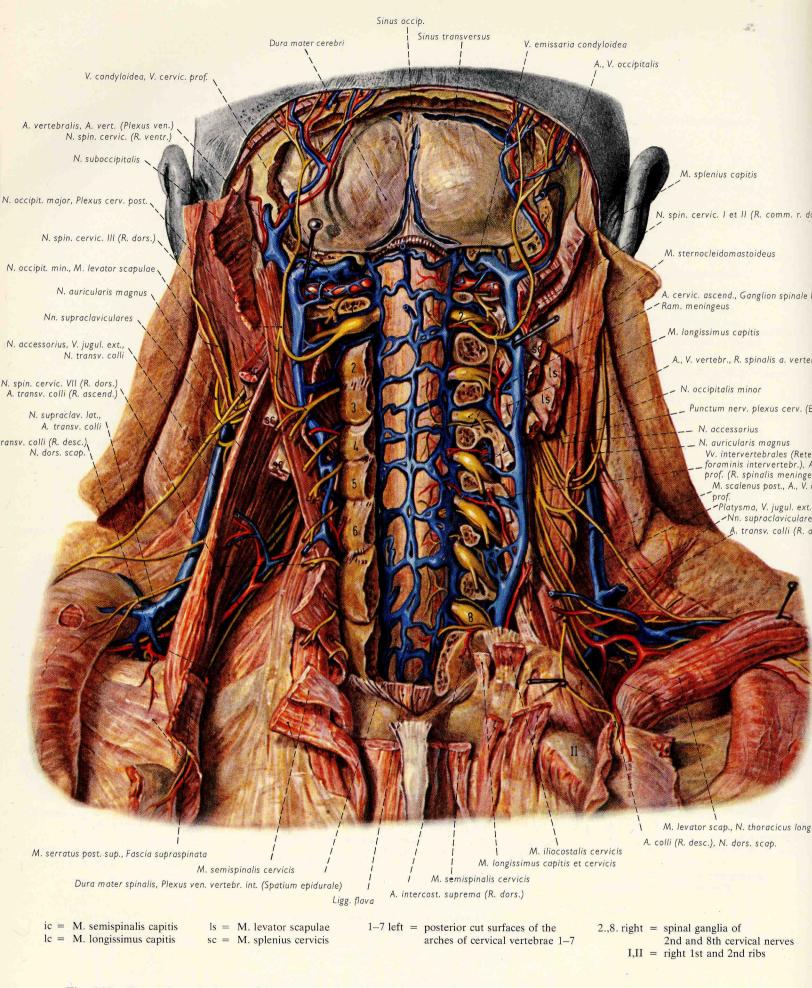


Fig. 292. Opened cervical part of the vertebral canal and the posterior cranial fossa from behind. Dissection of extradural structures, and the spinal and cranial dura mater. The laminectomy was performed in such a manner that the vertebral arches were sawed through behind the articular processes on the left side, and in front of the same on the right side. The right intervertebral foramina have been opened so that the roots and ganglia of the cervical nerves may be seen. The scalene muscles are retained on both sides, and the branching of the cervical plexus is brought into view.

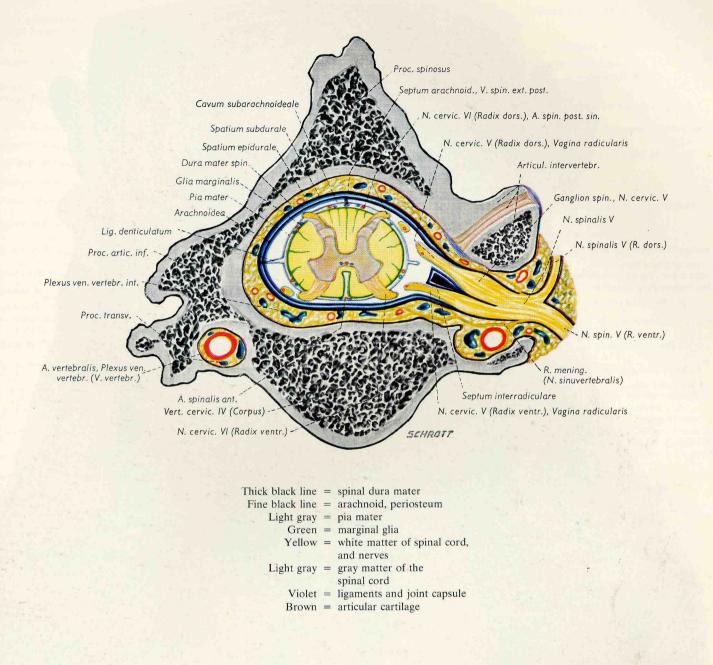
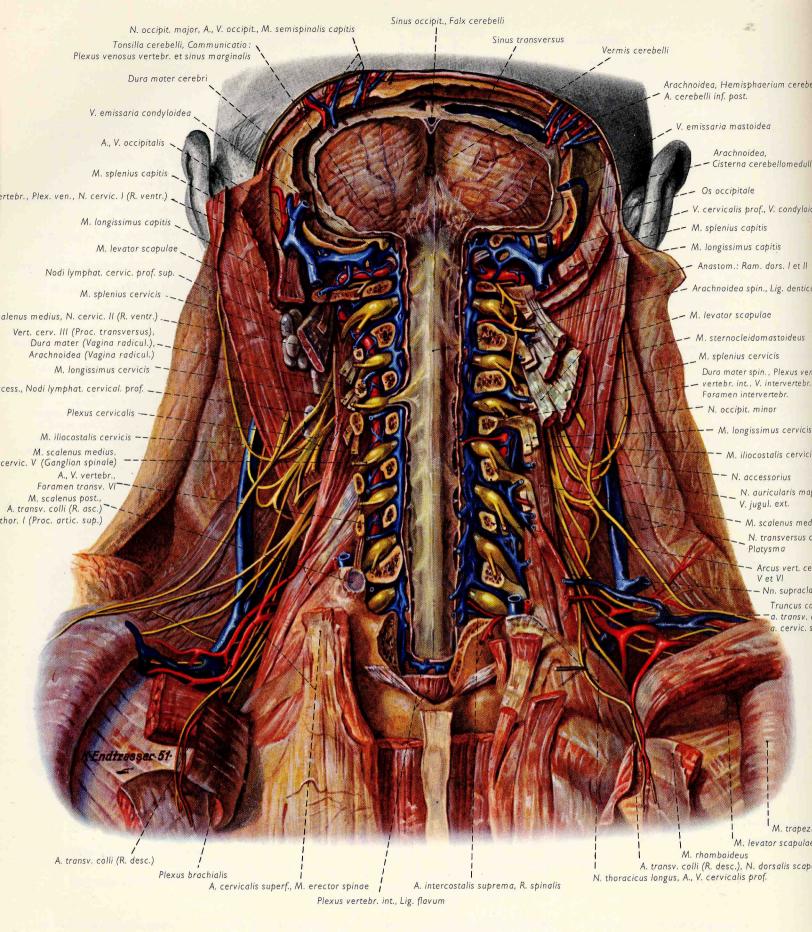


Fig. 293. Transverse section through the cervical vertebral column and the contents of the vertebral canal: the spinal cord and its investing membranes in cross section. Section through the body of the 4th cervical vertebra; on the right at the level of the transverse process, on the left somewhat deeper. On the left side the cut passes through the enclosed transverse foramen with the vertebral a. and v.



1-7 = cut roots of arches of cervical vertebrae 1-7

Fig. 294. Opened cervical vertebral canal and posterior cranial fossa seen from behind. The arachnoid sac, roots, and branches of the cervical spinal nerves are exposed by opening the intervertebral foramina. The internal vertebral venous plexus and its external connections as well as the vertebral a. are illustrated. The cervical plexus and its branches are seen from behind.

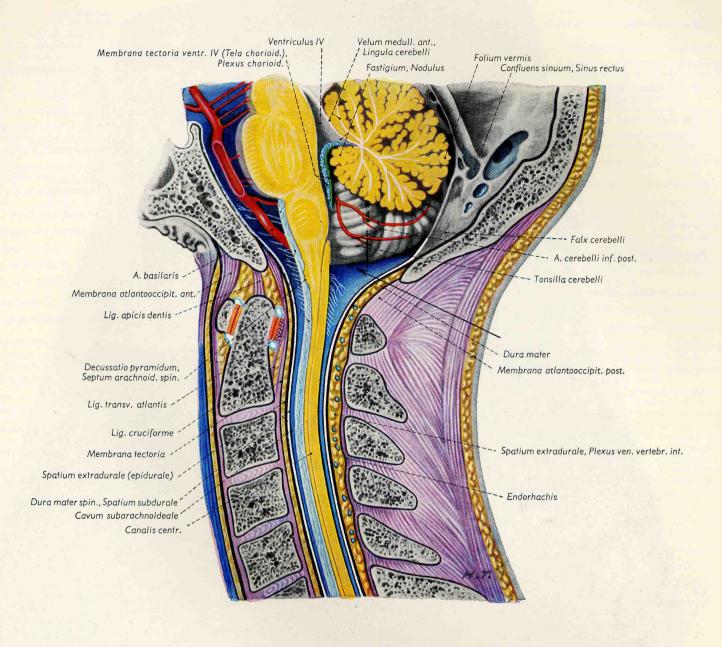


Fig. 295. Contents of the cervical vertebral canal and the adjacent portion of the cranial cavity in a median section. Cut surfaces of the cervical cord, brainstem, and cerebellum are colored yellow. The arrow indicates the position of the needle when doing a cisternal puncture; the tip of the needle is in the cerebellomedullary cistern and points approximately toward the median aperture of the 4th ventricle.

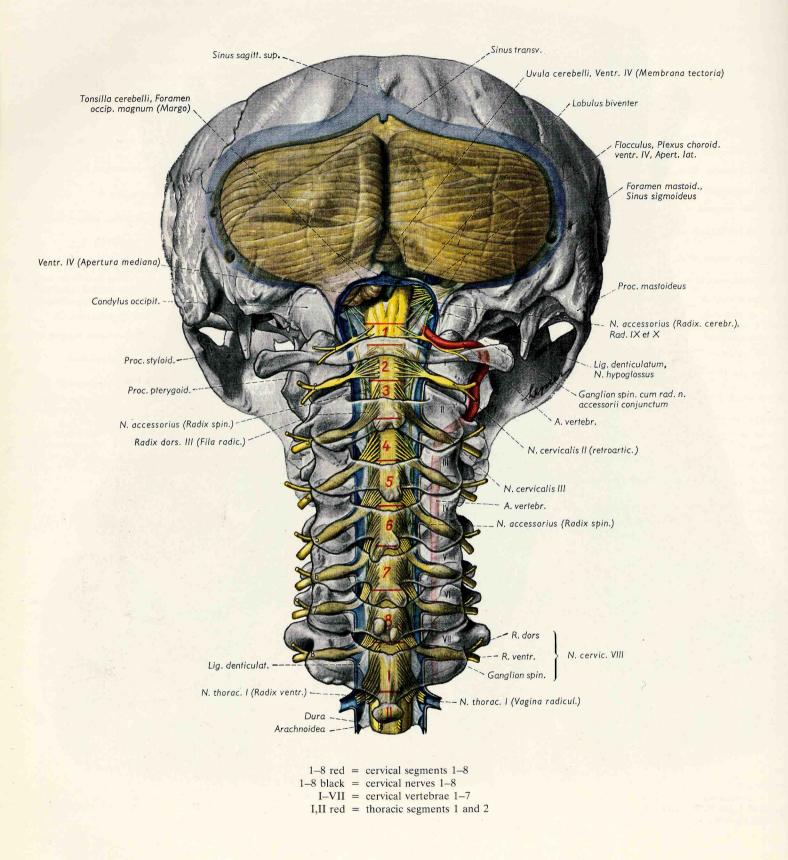
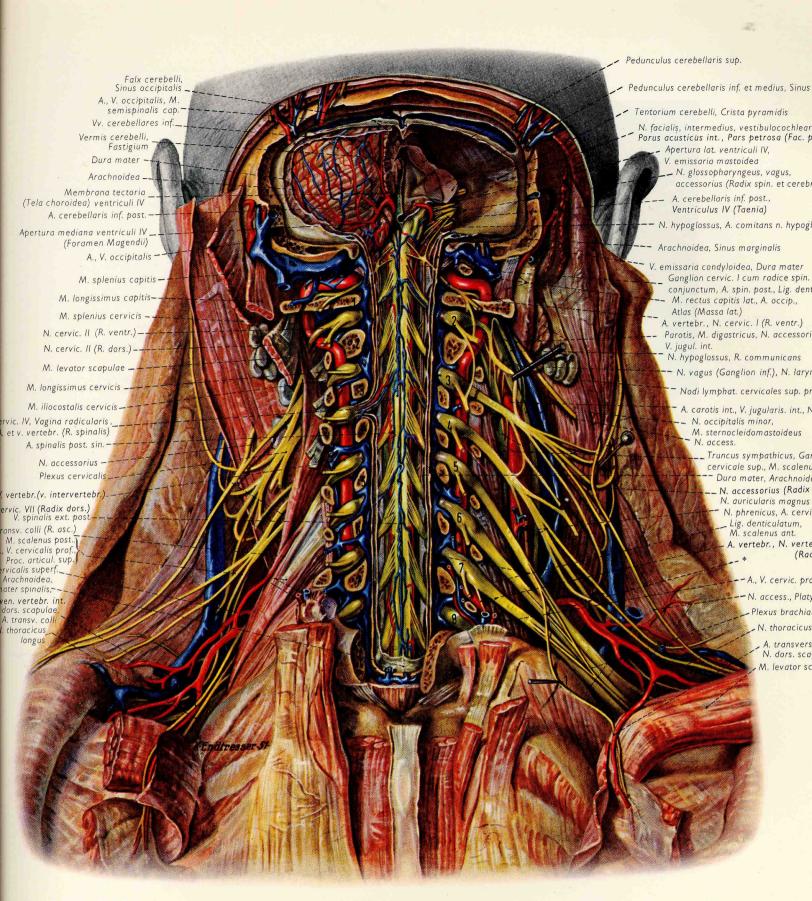


Fig. 296. The cervical portion of the spinal cord in situ within the vertebral canal with the associated parts of the brain, in a sagittal projection, and viewed from behind. The posterior wall of the vertebral canal and the cranial cavity are drawn translucent. The dural sac (black) and the arachnoidal sac (blue) appear as if cut in a frontal plane so that the spinal cord and the dorsal roots of the cervical nerves and the adjacent cranial nerves can be seen in this projection. The course of the vertebral a. is indicated.

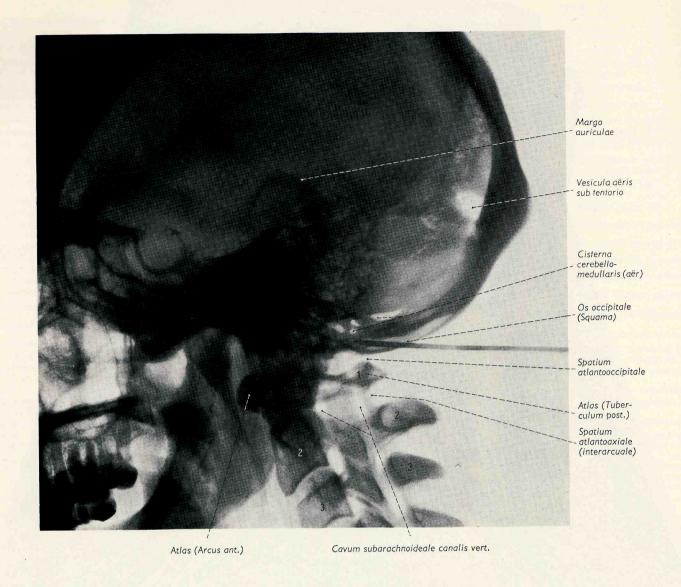


* = V. jugul. ext., Nn. supraclavicul., Truncus comm. a. transv. colli and a. cervic. superfic.

2–8 right = spinal ganglia of cervical nerves 2–8

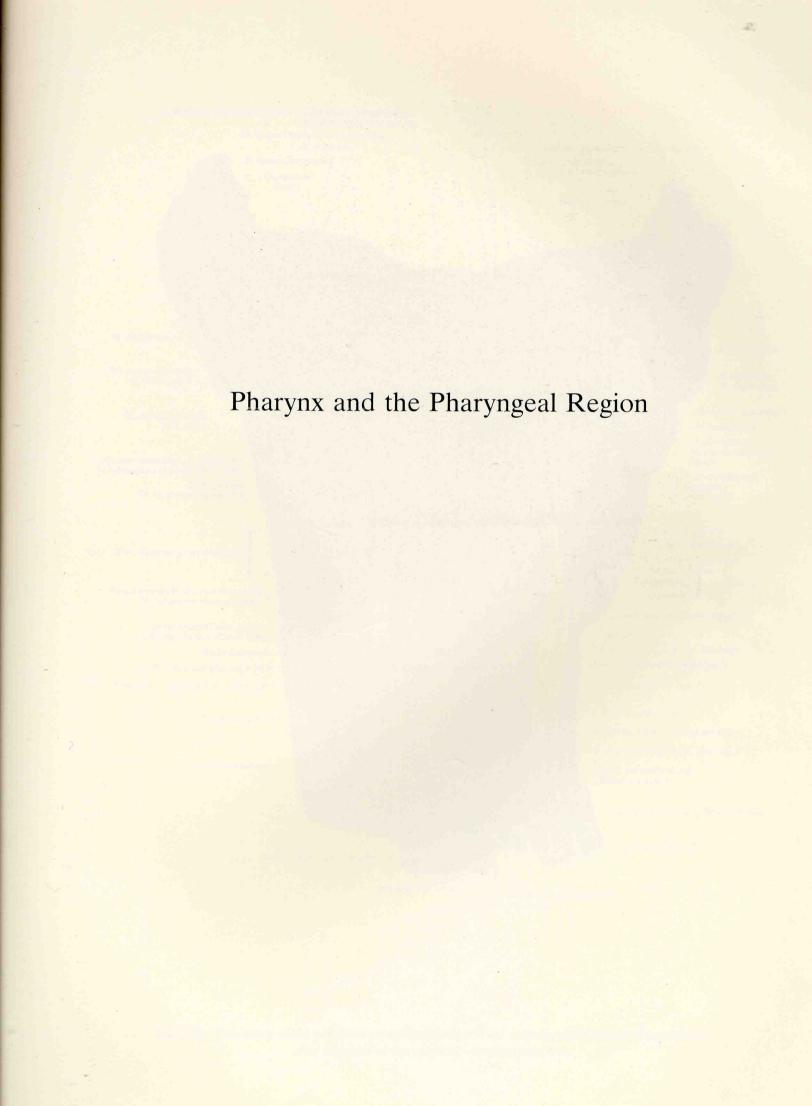
1–7 left = cut surfaces of the roots of the arches of cervical vertebrae 1–7

Fig. 297. Opened vertebral canal and posterior cranial fossa from behind. The dura and arachnoid have been removed in order to show the cervical spinal nerves and their roots, branches, spinal ganglia, the cervical plexus, the entire course of the vertebral a. in the neck, and the vertebral venous plexus. The right hemisphere of the cerebellum has been removed to show the rhomboid fossa, the crura of cerebellum, and the arachnoidal course of VII, VIII, IX, X, and XI.



1-3 = cervical vertebrae 1-3

Fig. 298. Roentgenogram (lateral, right-left) of the cerebellomedullary cistern filled with air. The cannula is introduced suboccipitally into the subarachnoid space (direct method).



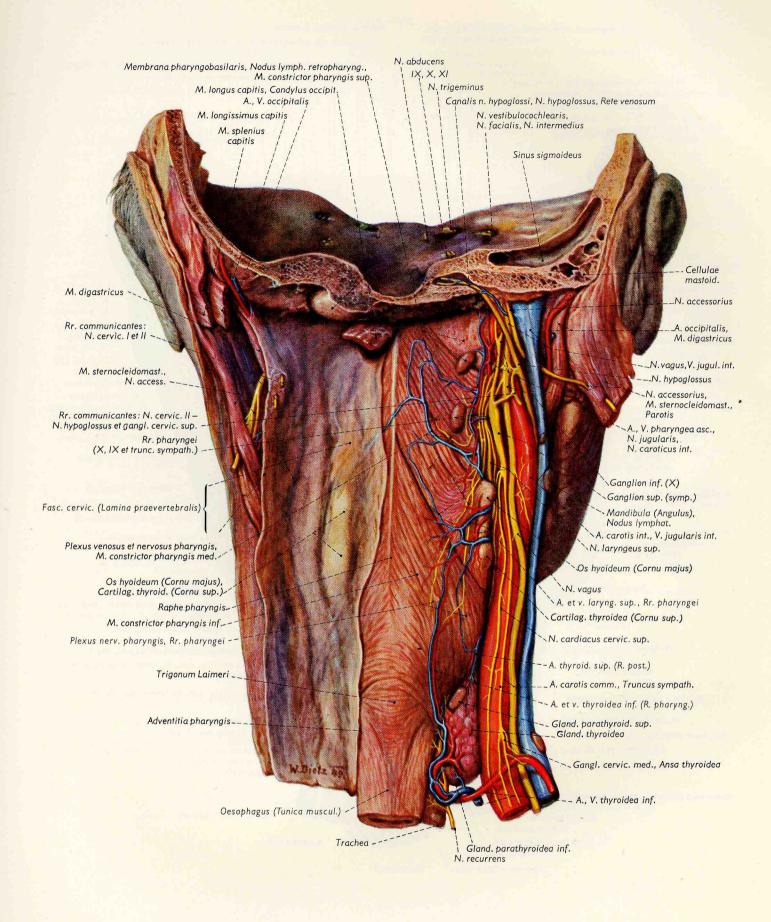


Fig. 299. Dissection of the posterior pharyngeal wall and the neurovascular bundle from behind after removal of the cervical vertebral column.

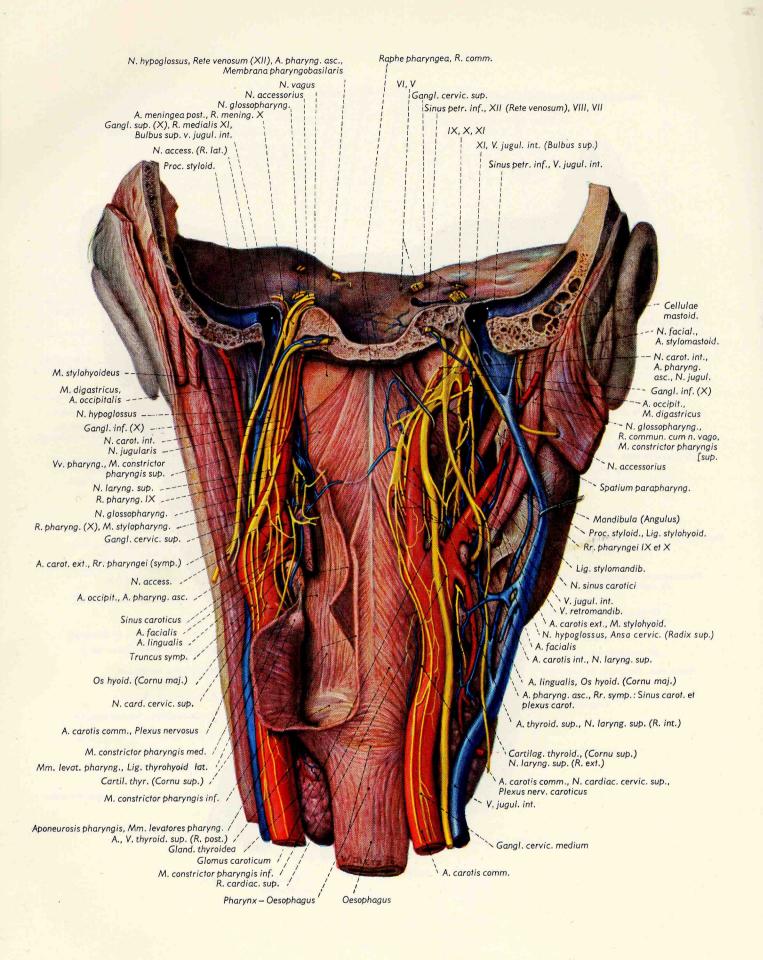


Fig. 300. Dissection of pharynx and the neurovascular bundles up to the cranial base, from behind. The section passes through the base of the cranium at the level of the jugular foramina.

Vessels and nerves of the pharyngeal space.

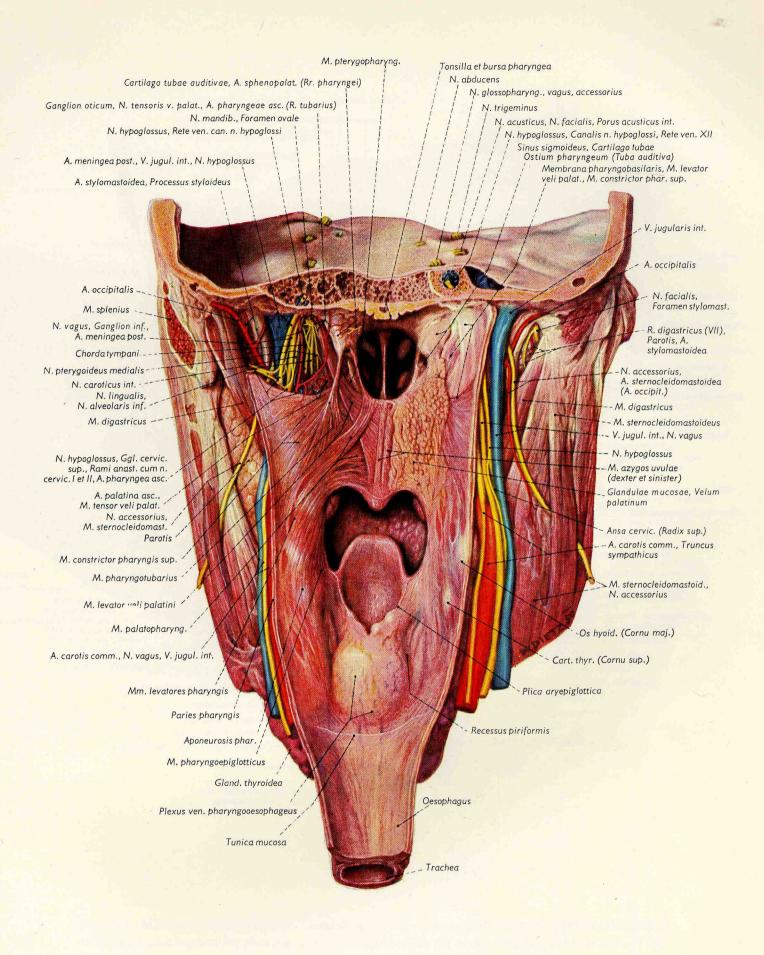


Fig. 301. Pharynx opened from behind, showing on the left the muscle layers of the pharyngeal wall from the inside, as well as the musculature of the soft palate.

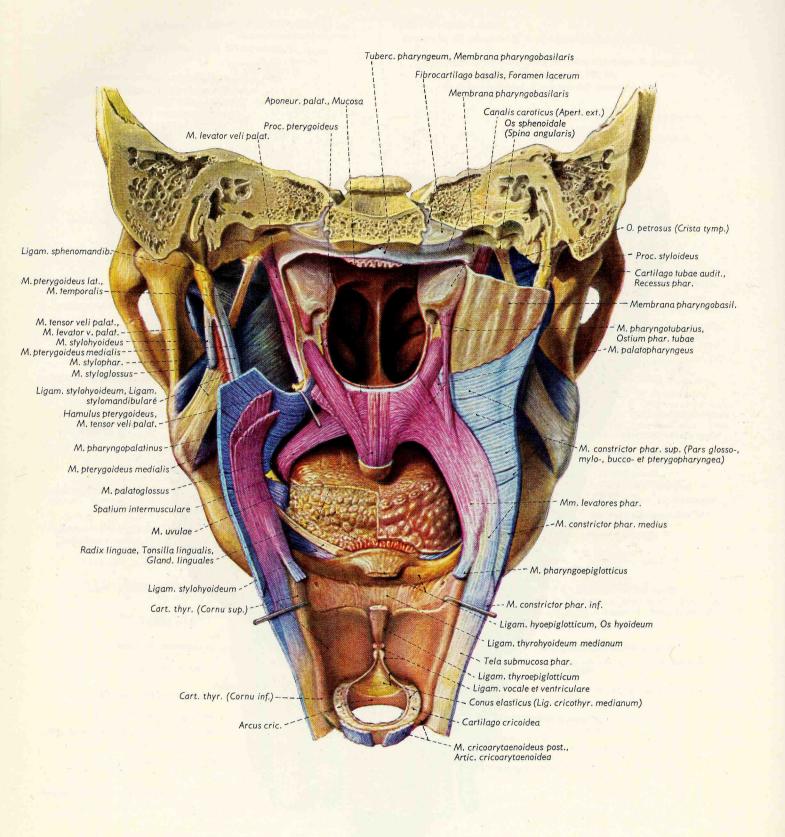


Fig. 302. Muscles of the pharynx and palate seen from behind and inside after removal of the mucosa.

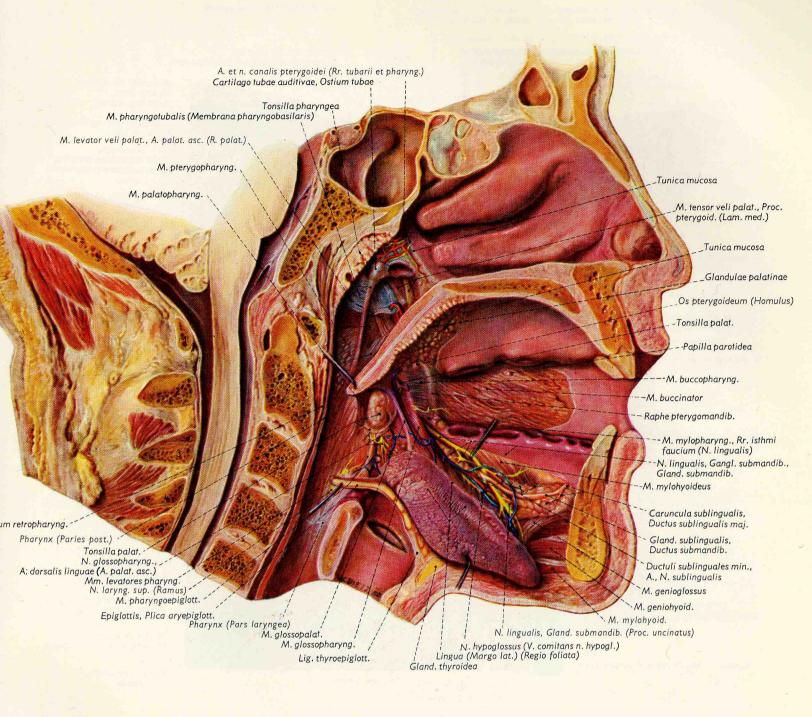


Fig. 303. Median section through the facial skeleton and pharynx. Left half of the section. Dissection of the muscular layer of the pharyngeal wall from the inside, the nerves and vessels at the base of the tongue, of the tonsillar region, and in the region of the auditory tube opening. The halved tongue has been retracted medially.

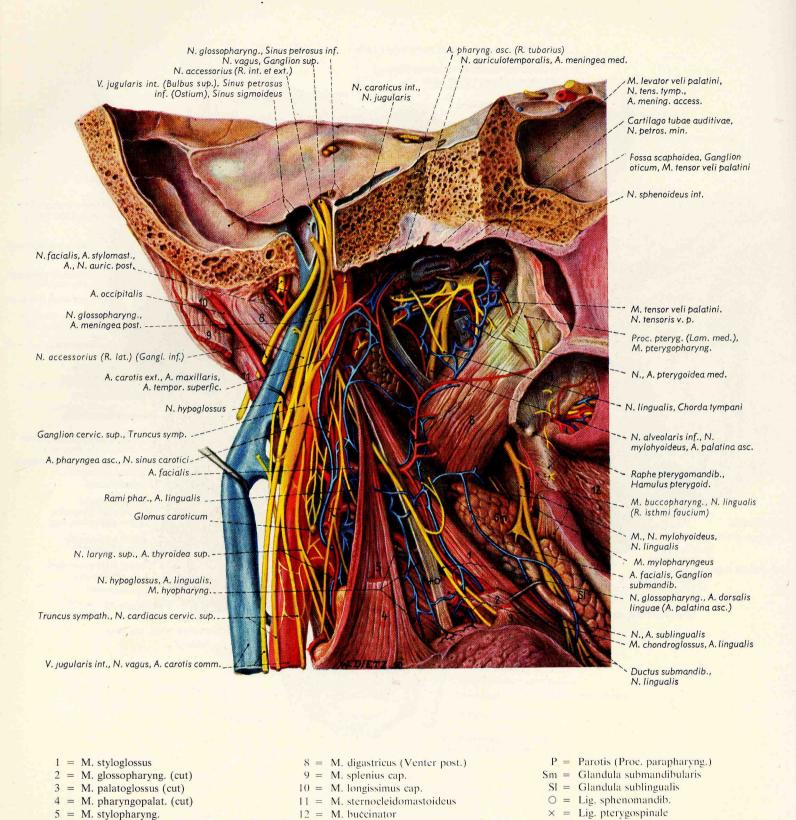


Fig. 304. Parapharyngeal structures seen from the medial aspect after removal of the pharyngeal wall. Dissection of the cervical neurovascular bundle up to the base of the skull. The infratemporal region with the branching of the mandibular nerve, the otic ganglion, the large salivary glands, and the course of the lingual and glossopharyngeal nerve, prepared from the medial side.

13 = aponeurosis of the palate

6 = lateral plate of the pterygoid process

7 = Lat. Lamelle of the Proc. pterygoideus

+ = Lig. stylomandibulare

 $+ \bigcirc = \text{Lig. stylohyoideum}$

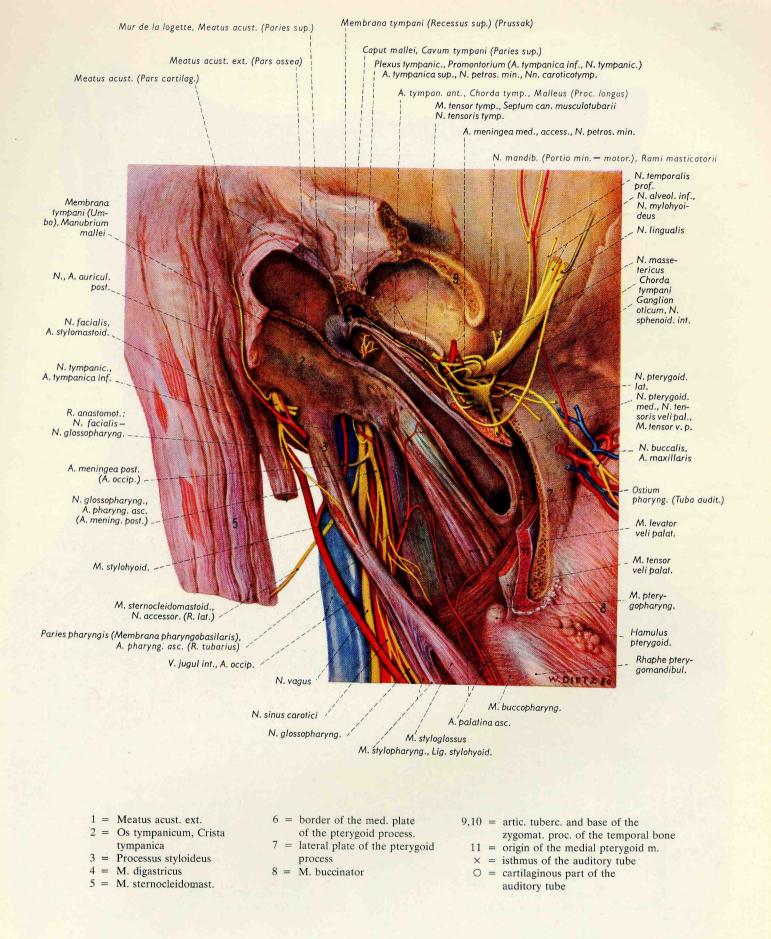
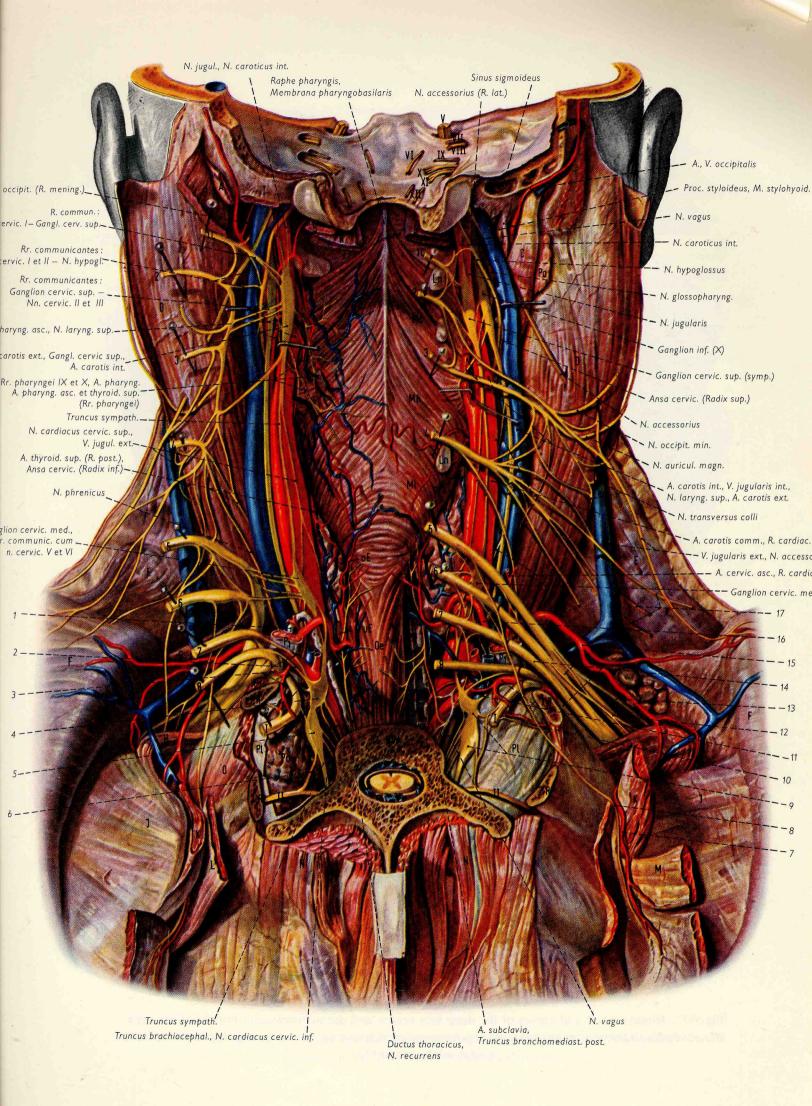


Fig. 305. Tympanic cavity and auditory tube. Area of the otic ganglion as well as nerves and blood vessels on the base of the skull. The external auditory meatus, the tympanic cavity, and the auditory tube have been opened from the lateral side. The main branches of the mandibular n. were cut, the optic ganglion reflected upward, and the tensor veli palatini m. pulled down.

1-8 = cervical nerve trunks 1-8Pu = lungoP = sup. pole of thyroid gland I.,II. = 1st and 2nd thoracic nerves 1.R = 1st ribR = M. longus cap. S = M. rectus cap. ant. 2.R = 2nd ribV-XII = cranial nerves V-XIITr = Trachea II.BW = 2nd thoracic vertebra 1 = Ductus thoracicus A = M. longissimus cap. 2 = communicating rami from 7th and B = M. splenius cap. 8th cervical nerves to inf. cervical C = M. digastricus ganglion (vertebral n.); D = M. sternocleidomast. vertebral a. and n. medial E = Platysmato these rami oE = sup. parathyroid gland 5 = 1st thoracic ganglion. uE = inf. parathyroid gland Communicating ramus to F = M. trapezius 1st thoracic n. 6 = communicating ramus to 2nd thoracic n. G = M. omohyoideus (Venter inf.) H = M. serratus ant. 7 = A. transversa colli (R. descend.) 8 = N. dors. scapulae J = M. supraspinatus K = M. levator scap. Ganglion stellatum (cervicale inf. and thoracale I) L = M. serratus post. sup. 10 = N. intercostalis I, A. intercostalis Ln = Nodi lymph. retropharyngei Me, mh, Ml = Mm. constrictores pharyngis suprema 11 = Truncus costocervic., Ansa subclavia N = M. erector spinae O = Mm. intercostales 12 = N. thorac. long. Oe = Oesophagus 13 = N. suprascapularis $P_1 = M$. scalenus ant. 14 = Plexus brachialis $P_2 = M$. scalenus med. 15 = A. transversa colli 16 = A. thyroidea inf. Pa = Parotis Pb = cupula of pleura 17 = Nn. supraclaviculares

Fig. 306. Dissection of cervical viscera and exposure of structures in the neurovascular bundle in situ from behind. (The vertebral column has been removed down to the 2nd thoracic vertebra; the base of the skull was cut in a frontal plane behind the condyles of the occipital bone, and the left cervical nerve trunks have been retracted laterally.



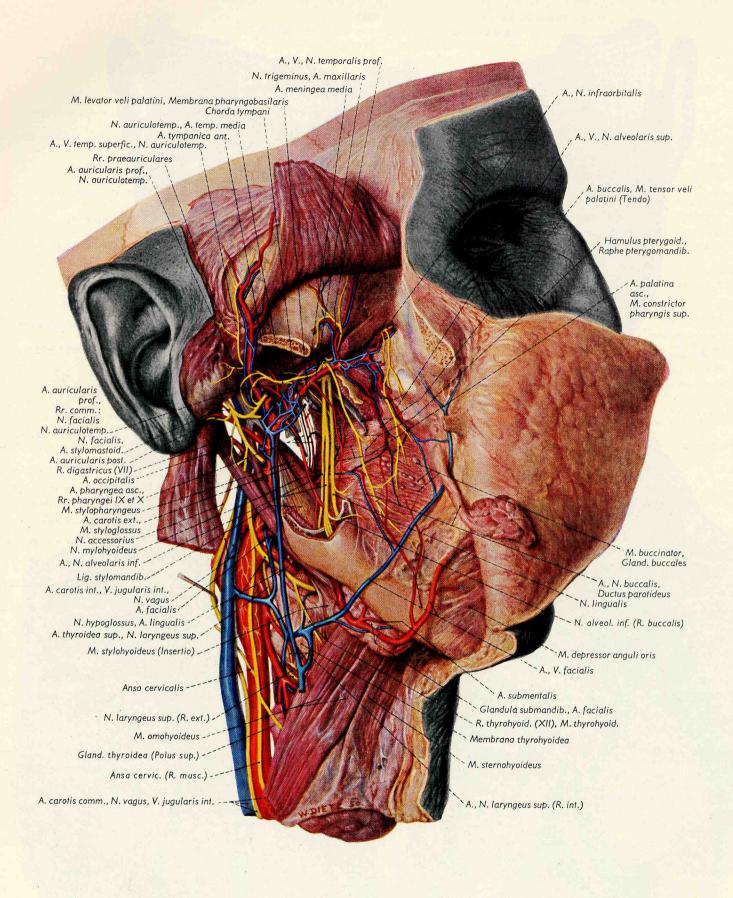


Fig. 307. Blood vessels and nerves of the deep face region and the neurovascular bundle of the neck. Blood vessels and nerves of the pterygoid region are exposed after resection of the zygomatic arch and the ramus of the mandible.

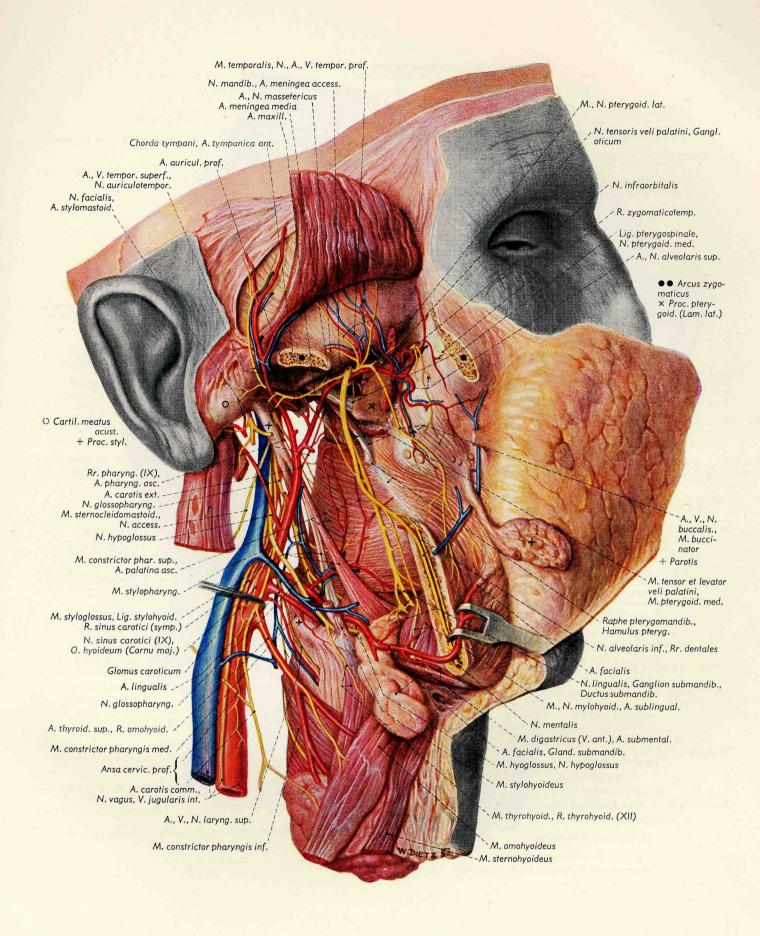


Fig. 308. Dissection of the cervical neurovascular stalk up to the base of the skull. Division of the mandibular n. into its branches.

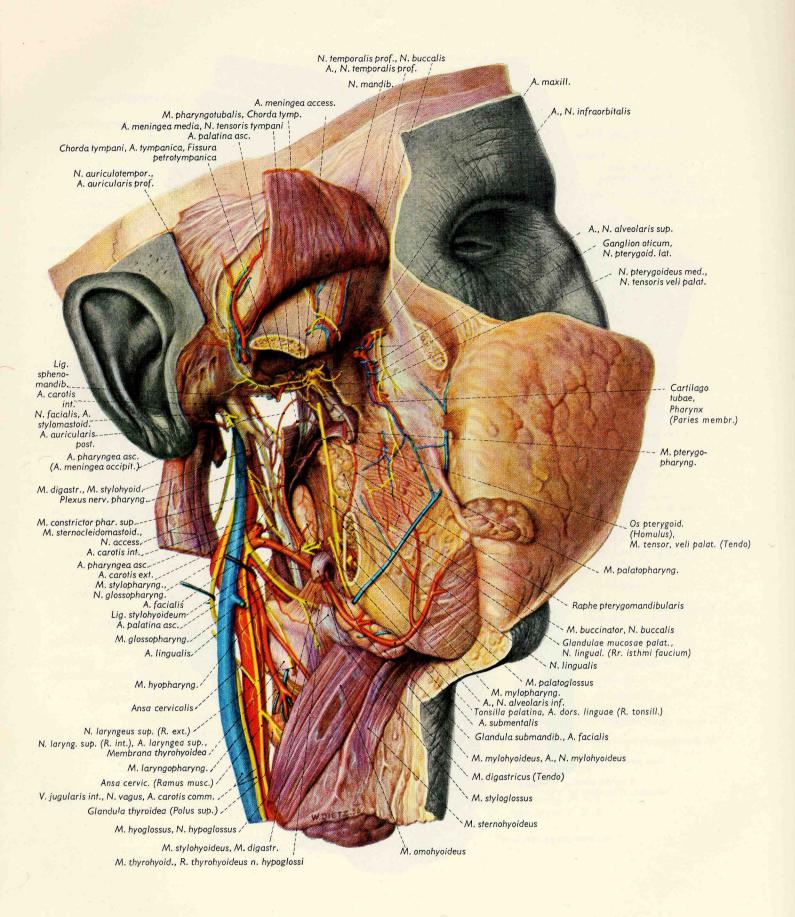


Fig. 309. Structures of the neck from the lateral side. The cervical vertebral column has been removed; the zygomatic arch and the ramus of the mandible have been cut, the former in front and in the back, and removed with the muscles of mastication after disarticulation of the temporomandibular joint. With maximal depression of the mandible, access is gained to a large area of the lateral pharyngeal wall.

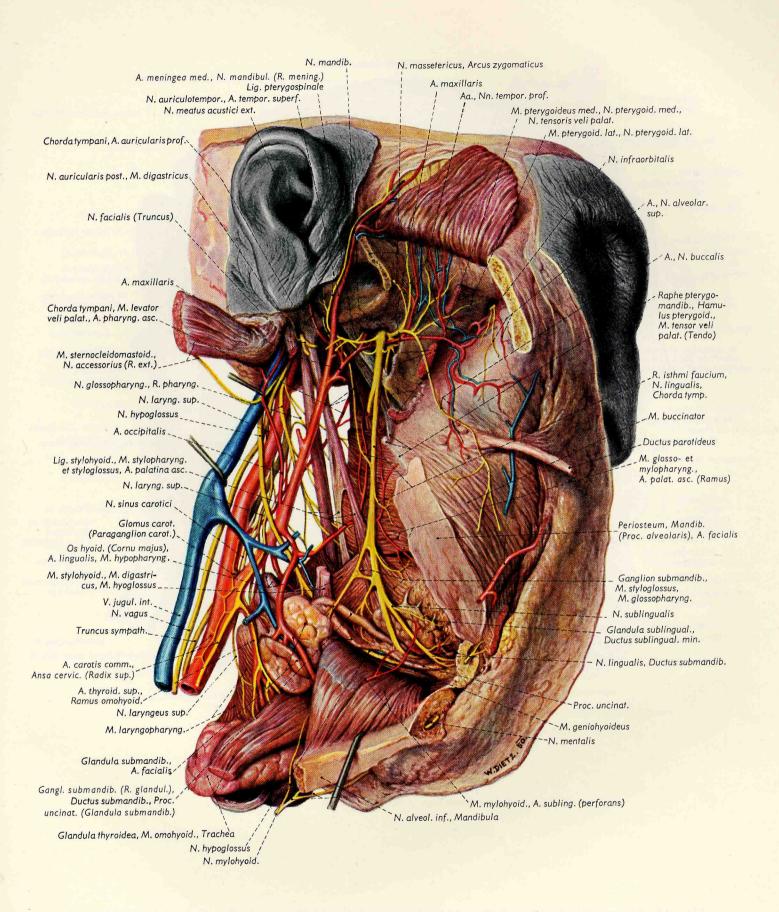


Fig. 310. Dissection of the right cervical neurovascular bundle. The right half of the body of the mandible has been sawed through in a parasagittal plane, freed subperiosteally, and retracted downward with the mylohyoid m. in order to expose structures in the sublingual region (anomalous course of the maxillary a. medial to the mandibular nerve trunk; the ascending pharyngeal a. arises here from the internal carotid a.). View of the course and branches of the maxillary a.

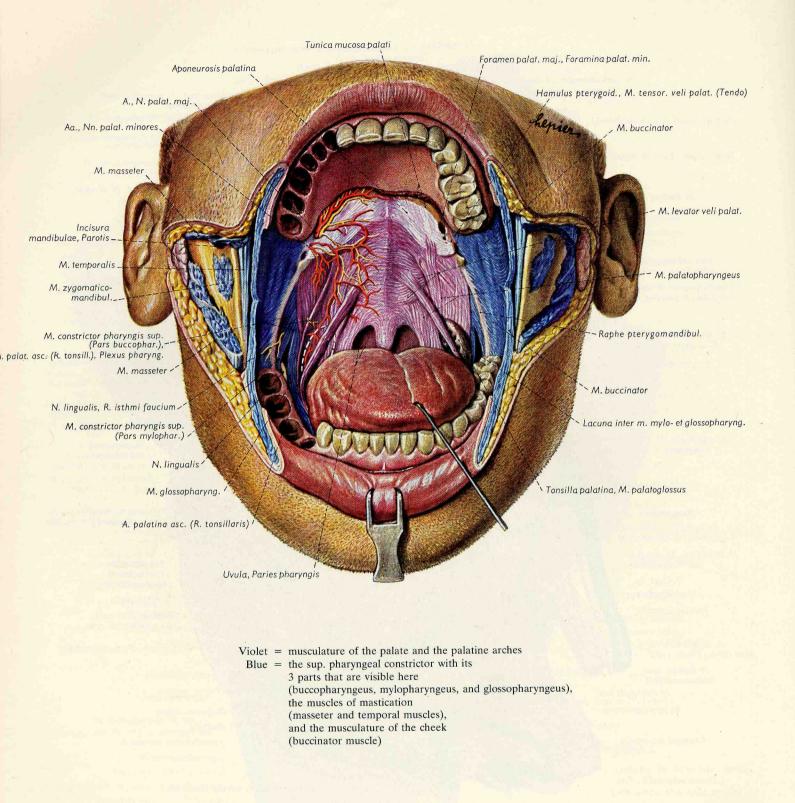
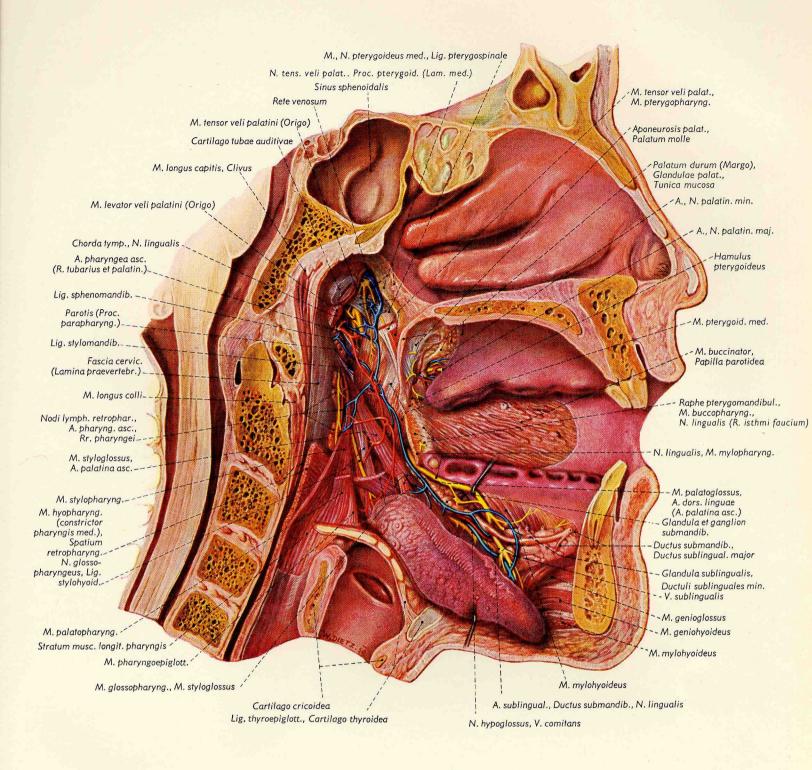


Fig. 311. Topographical relationships and blood supply of the palatine tonsil; dissection of the palatine musculature from the oral side (semischematic).



1-5 = median section of cervical vertebrae 1-5

Fig. 312. Median section through the facial skeleton and the pharynx. Dissection of the pharyngeal and palatine musculature from the inside; vessels and nerves in the tubal and sublingual regions.

Larynx

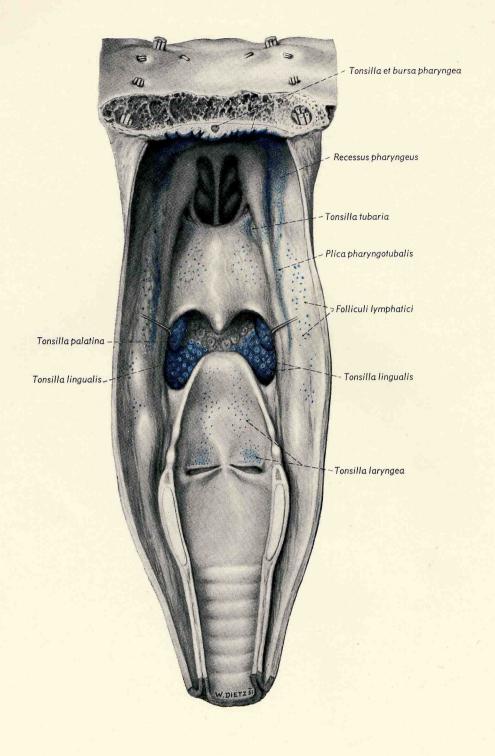


Fig. 313. The distribution of tonsillar tissue in the mucosa of the upper respiratory and gastrointestinal tracts. The lymphatic rings near the anterior apertures of the pharynx and the lateral columns in the pharyngeal wall are colored blue (semischematic). Pharynx and larynx are opened in the posterior midline.

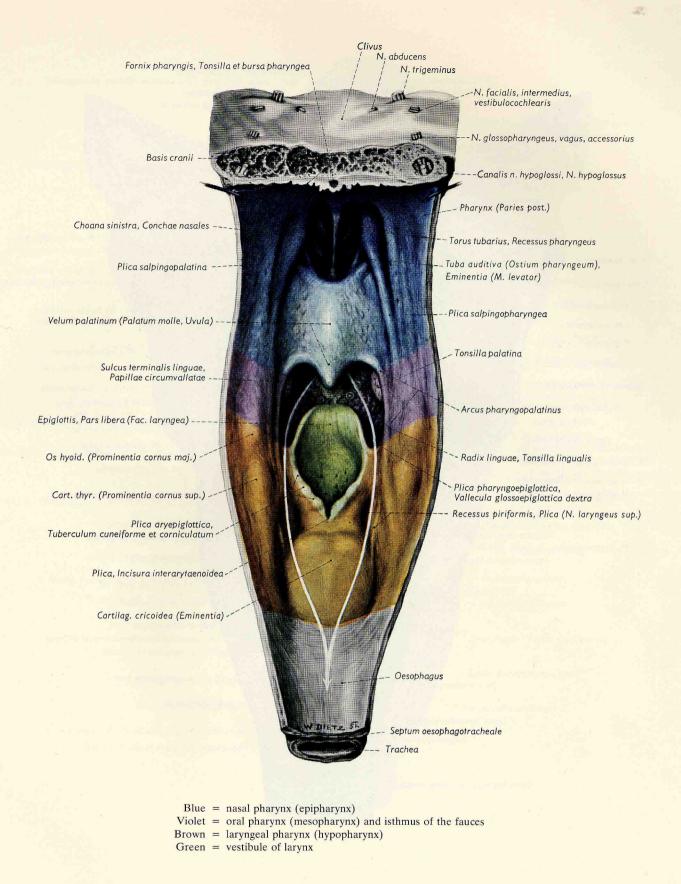


Fig. 314. Regions of the pharynx and entrance into larynx (aditus). The 3 levels of pharynx, opened from behind. The food-conducting channels that run from the isthmus of the fauces, on both sides of the epiglottis, over the piriform recess, and then reunite in the esophagus are indicated by white lines.

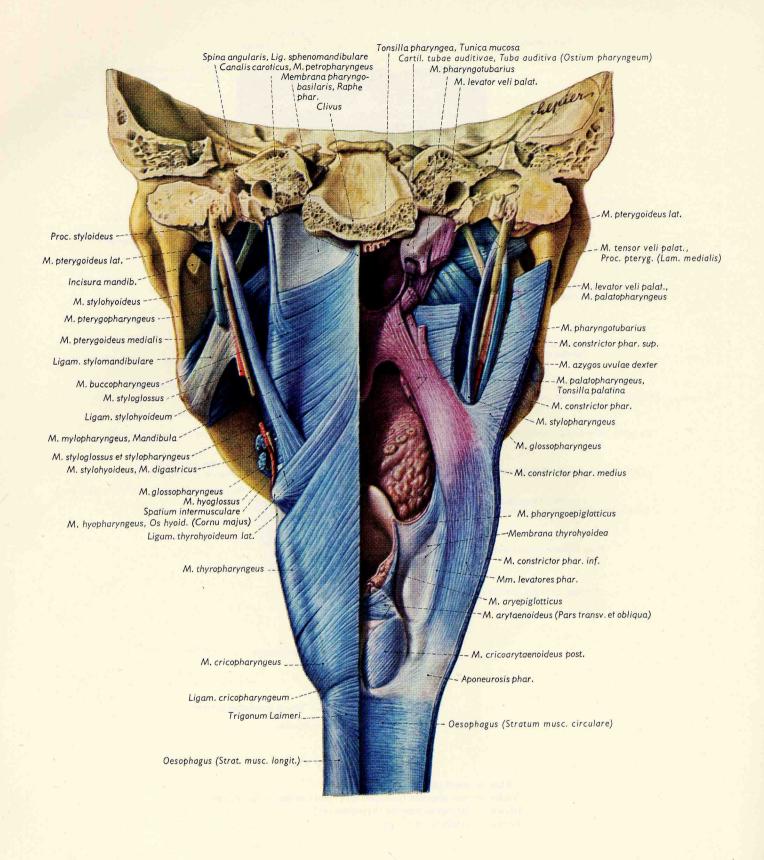


Fig. 315. The musculature of the pharynx shown from behind. The right half of the pharynx has been reflected laterally. On the left side pharyngeal muscles are seen from the outside; on the right the pharyngeal and palatine muscles may be viewed from the inside.

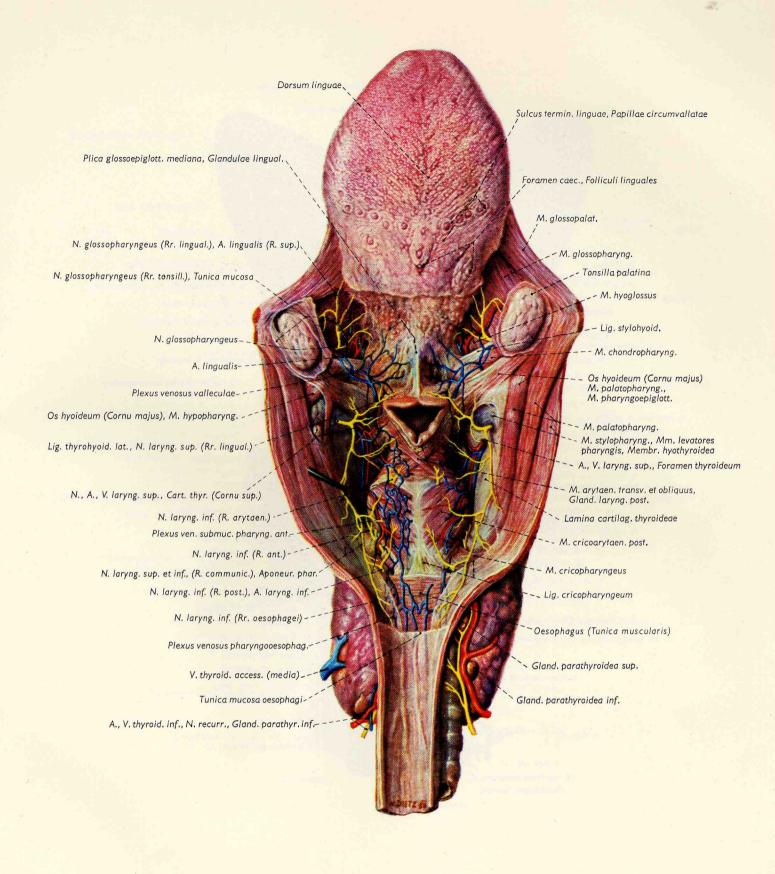


Fig. 316. Muscles, vessels, and nerves on the back side of the larynx, in the posterior tongue region, and in the regions of the palatine tonsils and the glossoepiglottic valleculae. Pharynx and esophagus have been opened from behind so that a posterior entry may be made into the paralaryngeal submucosal space after removal of the pharyngeal mucosa (of the piriform recess). The thyroid and parathyroid glands.

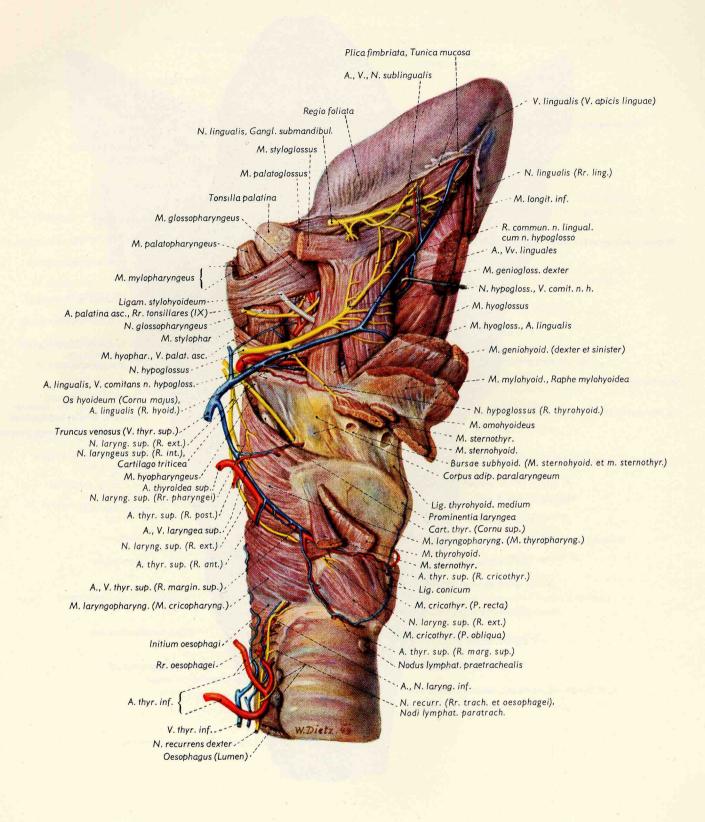


Fig. 317. Dissection of muscles, vessels, and nerves on the ventrolateral aspect of larynx and pharynx after removal of the suprahyoid and infrahyoid muscles, and resection of the thyroid gland. Muscles, nerves, and vessels at the base of the tongue.

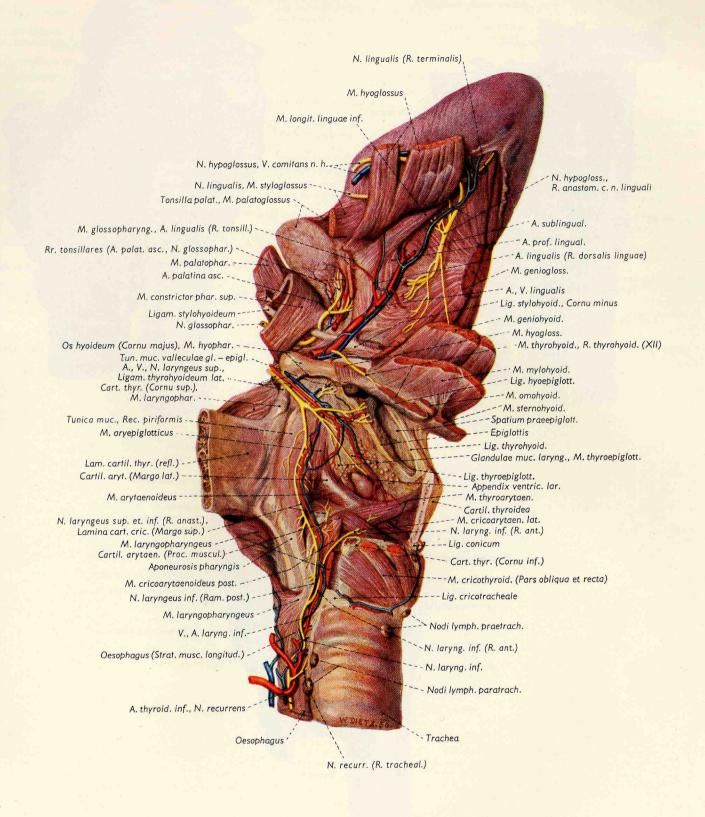
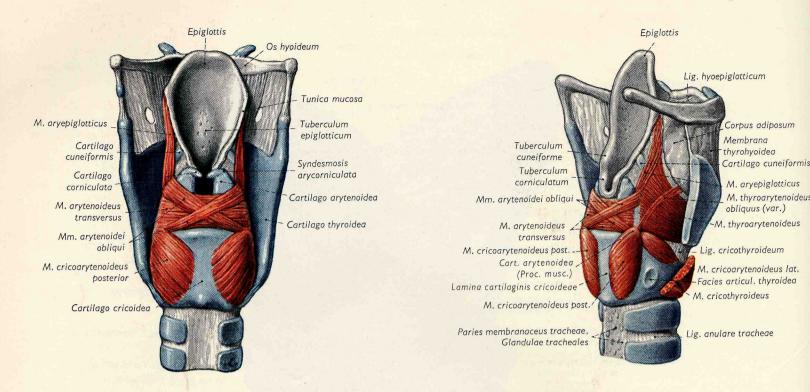


Fig. 318. Deep muscles, vessels, and nerves on the ventrolateral aspect of the larynx. The thyroid cartilage has been cut parasagittally and reflected back after freeing it from the underlying structures without disturbing the mucosa of the piriform recess and larynx. The hyoglossus m. has been removed in order to show the course of the lingual a. and the glossopharyngeal n., as well as the attachment of the stylohyoid lig. to the lesser horn of the hyoid bone.



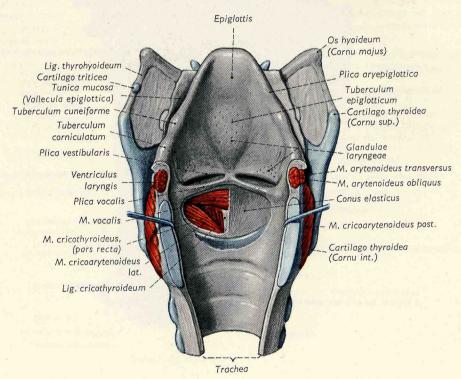


Fig. 319. (Top, left) Muscles on the dorsal surface of larynx (from Sobotta/Becher).

Fig. 320. (Top, right) Posteroinferior view of laryngeal musculature (from Sobotta/Becher).

Fig. 321. (Bottom) Larynx opened in the dorsal midline and spread apart by retractors. The mucosa has been removed between the vocal fold and the upper edge of the arch of the cricoid cartilage, and the musculature of the left side has been dissected from the inside (from Sobotta/Becher).

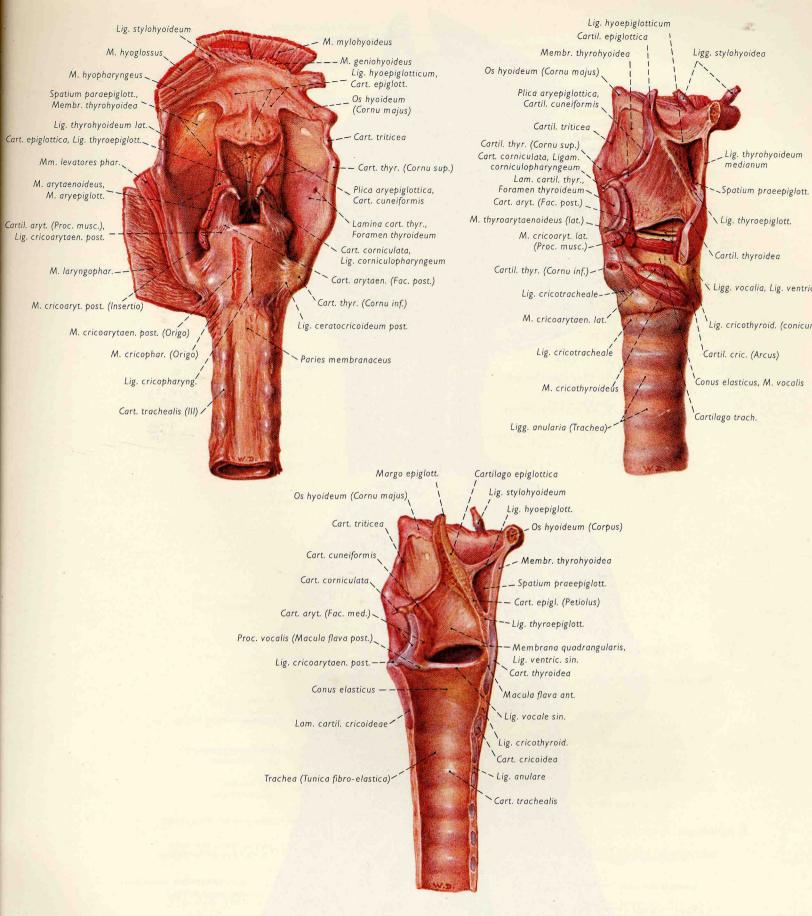
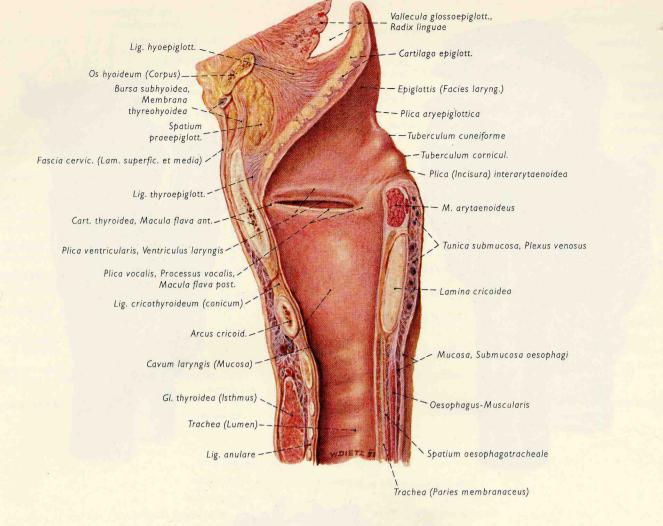
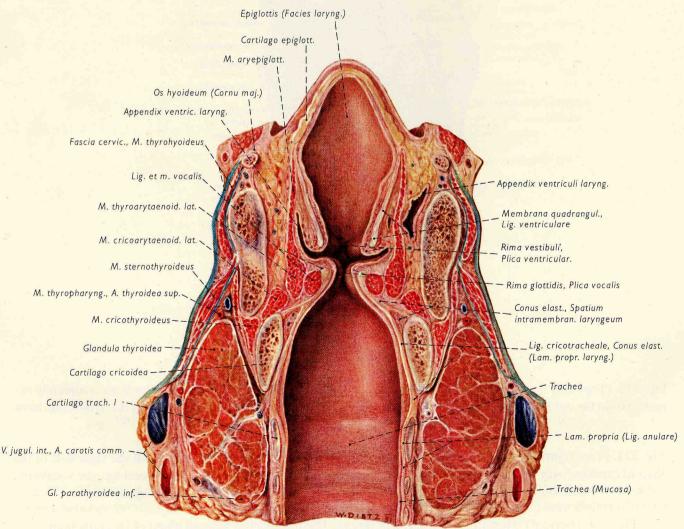


Fig. 322. (Top, left) Larynx seen from behind. The musculature of pharynx and larynx has been completely removed from the right side; the origins and isertions of this musculature as well as the muscles of the hyoid bone have been retained on the left side (epiglottis is pulled down somewhat).

Fig. 323. (Top, right) Larynx seen from the side. The right greater horn of the hyoid and the right half of the thyroid cartilage with the thyrohyoid membrane are removed. The elastic cone with the vocal lig., the vocalis m., and the quadrangular membrane with the ventricular lig. are seen on the right side.





Green = cut edges of the cervical fascia including both laminae

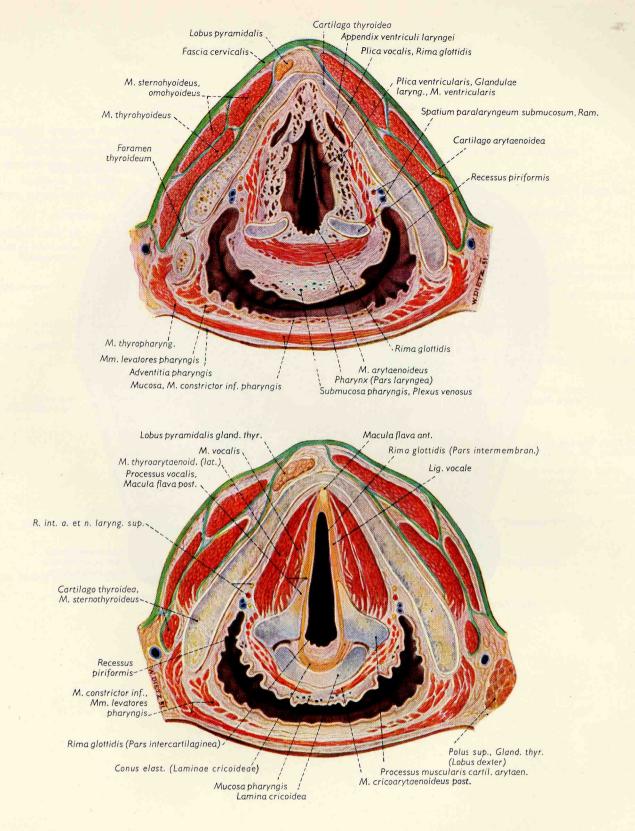


Fig. 327. (Top) Transverse section through larynx and pharynx at the level of the ventricular fold (cut fascial edges are green).

Fig. 328. (Middle) Transverse section through the larynx and pharynx at the level of the vocal fold (cervical fascia investing the infrahyoid muscles is green).

Fig. 325. (Left, top) Midsagittal section through larynx. The figure illustrates larynx with the adjoining part of the trachea and the root of the tongue in med. section (right half of specimen).

Fig. 326. (Left, bottom) Frontal section through the larynx and the 2 lobes of the thyroid gland showing the larynx, the 3 compartments of the laryngeal space, and the adjacent portion of the trachea. Anterior half of the specimen seen from behind. On the right side, in the submucosal paralaryngeal space, is seen a markedly expanded appendix of the laryngeal ventricle.

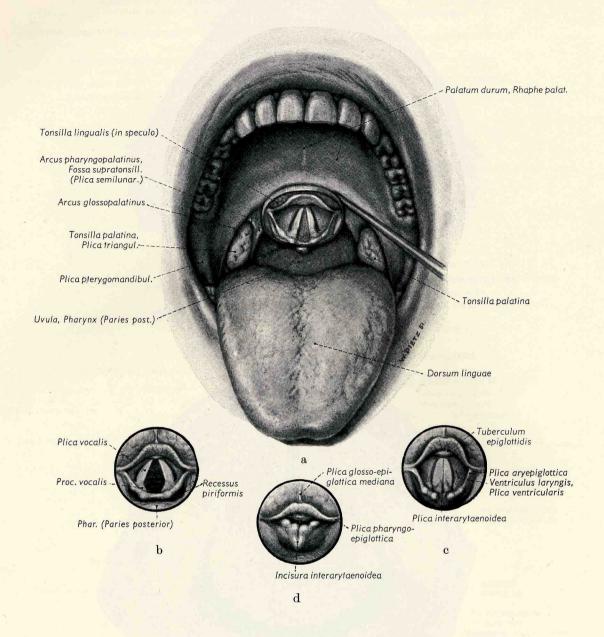


Fig. 329. Laryngoscopic view. With the mouth wide open, protracted tongue, and the head bent slightly backward, the mirror has been placed against the soft palate at an angle of approximately 45° in such a way that the uvula is completely covered, and the inferior edge of the mirror touches the posterior pharyngeal wall (illumination "normal"). In the mirror the image of the interior of larynx is reversed with anterior becoming superior, and posterior becoming inferior.

a) shows the rima glottidis during quiet breathing, triangular in shape, and with approximately the same appearance as that seen in a cadaver (intermediate position); b) shows the rima glottidis during deep inspiration, pentagonal in shape (abduction, respiration position); c) shows rima glottidis completely closed (adduction, median, or phonation position); d) shows the aditus of larynx almost completely closed by the approximation of the small cartilages in the aryepiglottic folds; the epiglottis (free part) is not completely folded back.

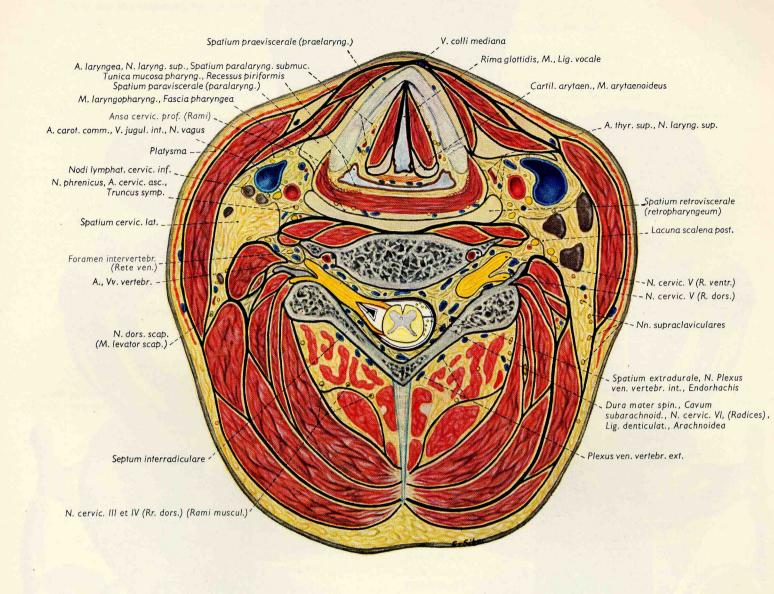
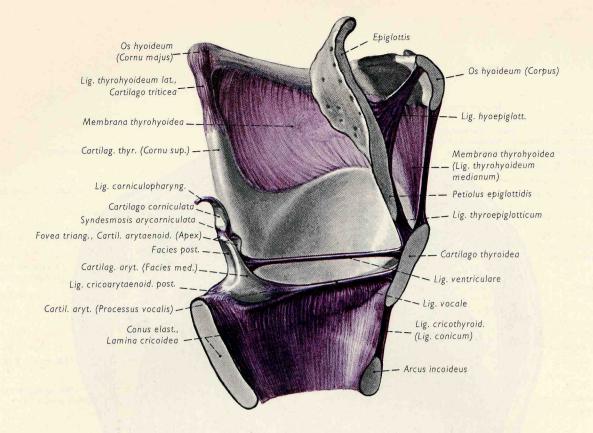
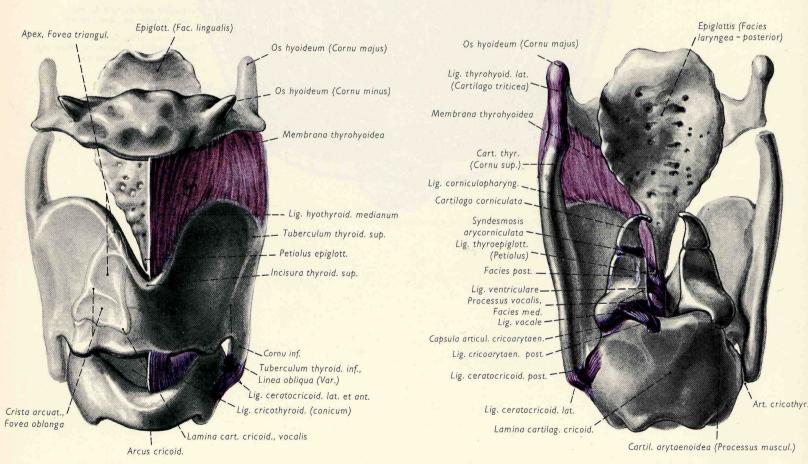


Fig. 330. Transverse section through the neck at the level of the glottis with the contents of the neural and visceral compartments. Illustration of the viscera, the cervical neurovascular bundles, and sheaths in cross section. Plane of section through the 5th cervical vertebra and the vocal cords. The cut edges of fasciae, periosteum, and spinal cord investments are black; those of the neurovascular sheaths are lighter in color.





blue = ligaments, quadrangular membrane not shown

Fig. 331. Skeletal framework and ligaments of larynx. a) Medial view of the left half. b) Viewed from front (right arytenoid cartilage is seen through the thyroid cartilage). c) View from behind.

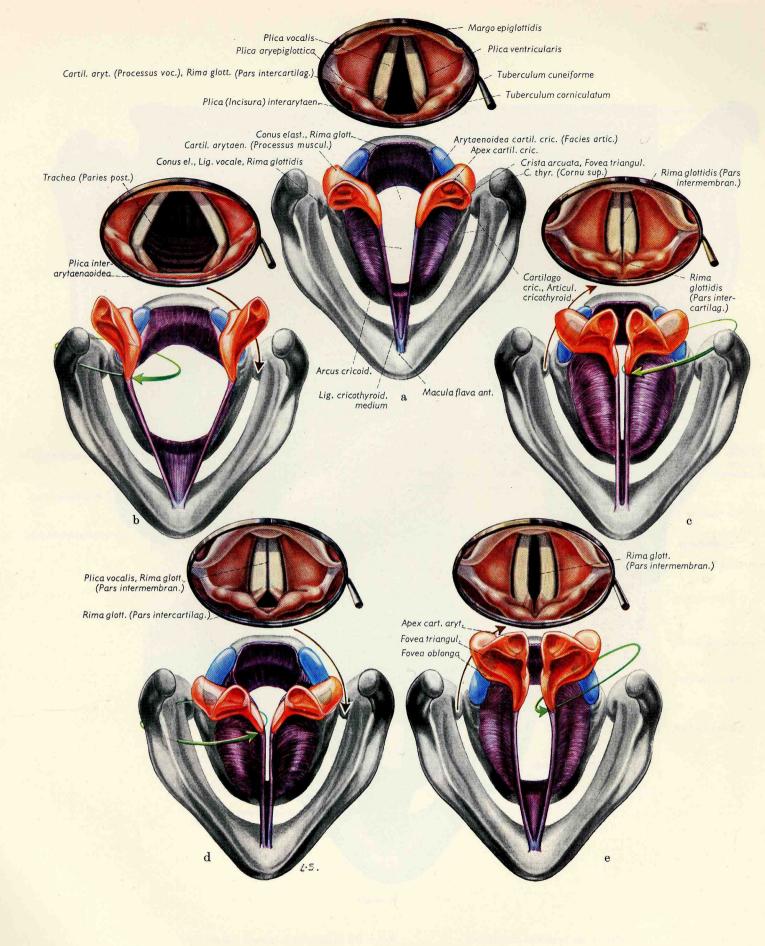


Fig. 332. The shapes of rima glottidis as seen on a skeletal preparation and in the mirror during resting phase (a), respiratory phase (b), and phonation (c); (d) rima glottidis when whispering; (e) rima glottidis in falsetto voice.

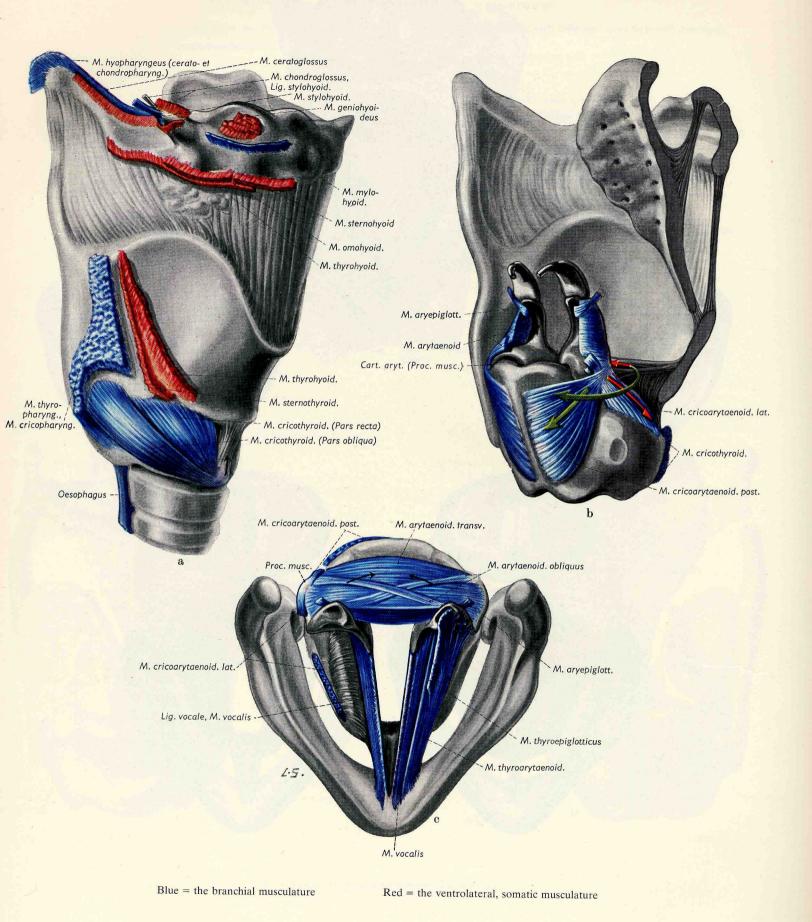


Fig. 333. Muscles of the larynx and their actions when contracting (arrows).

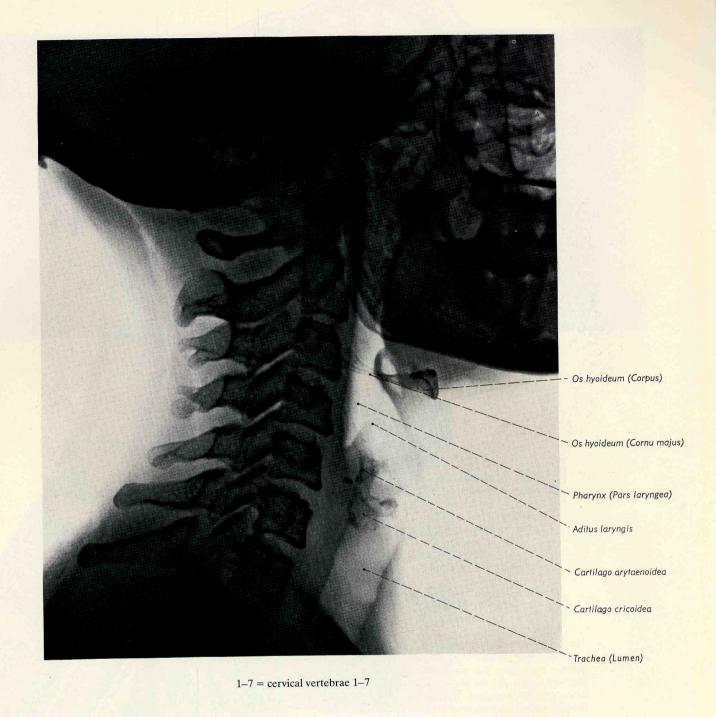


Fig. 334. Lateral roentgenogram of the soft structures in the laryngeal and tracheal regions (from R. Kraus, Heidelberg).

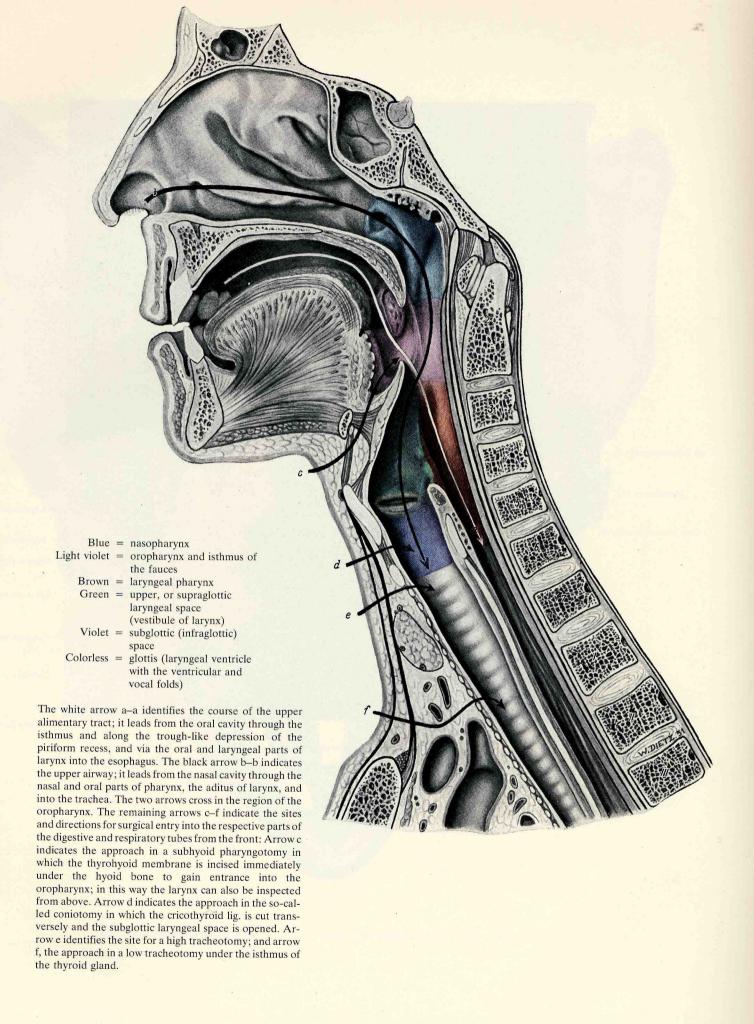
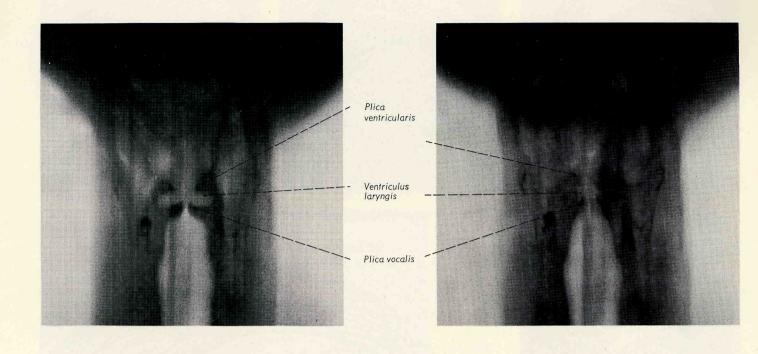


Fig. 335. The various levels of the larynx and pharynx in midsagittal section (view of the right half of the specimen).



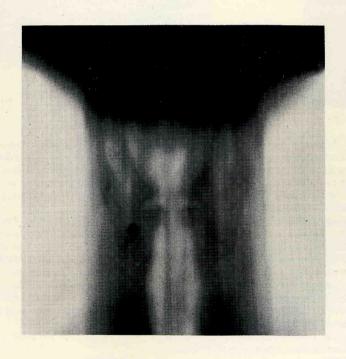
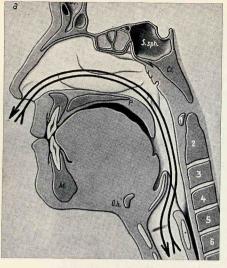
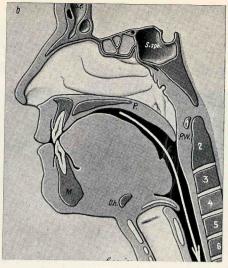


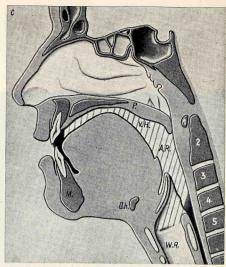
Fig. 336. (Top, left) Tomogram of larynx (A-P) during pronounciation of the vowel "u" (depth of field 16 cm) (from R. Kraus, Heidelberg).

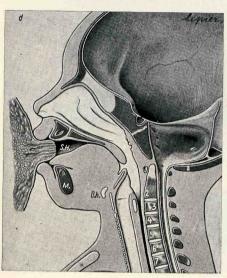
Fig. 337. (Top, right) Tomogram of larynx during normal respiration (from R. Kraus, Heidelberg).

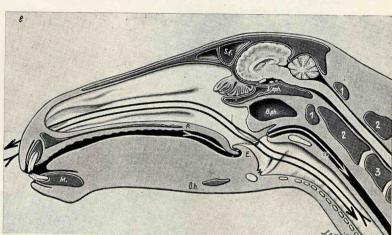
Fig. 338. (Bottom) Tomogram of larynx during deep inspiration (from Prof. Dr. R. Kraus, Heidelberg).











- a) During quiet respiration the airway (white) appears wide open toward pharynx; the upper and lower parts of the airway indicate the direction of the air flow during inspiration and expiration.)
- b) During the act of swallowing the upper and lower airways are closed off from the oropharynx by the soft palate (Passavant's cushion) and the epiglottis, respectively; only the digestive tract (black) is open; the white arrow indicates the direction in which the bolus moves toward the esophagus.
- c) The process of phonation while pronouncing a vowel. The airway is white and the channel used is cross-hatched. Although the upper airway can be sealed off by the soft palate, it must not be totally isolated; the nasal passages may serve an important function by adding a nasal quality to the sound of a vowel. (The soft palate is elevated the least when the vowel "a" is expressed.)
- d) The act of sucking (median section of the head and neck of a newborn). The oral cavity as a suction pump (indicated in black) is closed off from the pharynx by means of the soft palate and the root of the tongue; the airway is open so that breathing may take place during the act.
- e) The intranasal larynx (median section through the head and neck of a mammal, the horse). The airway (white, black arrows) as well as the passage of food (black, white arrows) which is split in the pharynx by the epiglottis, appear open and passable. The 2 pathways (arrows) cross in the oropharynx where the white arrow lies to the side of the epiglottis in the channel provided by the isthmus of the fauces and the piriform recess.

A.R. = oropharynx B.ph = pharyngeal bursa

Cl = clivus E = epiglottis M = mandible O.h. = hyoid bone

P = soft palate
P.W. = Passavant's cushion

S.f. = frontal sinus S.sph. = sphenoid sinus S.H. = suction cavity

V.H. = vocal cavity

W.R. = windpipe

1-7 = cervical vertebrae 1-7

Fig. 339. The craniocervical digestive and respiratory tracts in midsagittal section.

Index

This condensed index includes only material found in this volume. A complete and comprehensive index covering both volumes of this atlas may be obtained separately from the publisher.

Acromion (scapula) 233 Adhesion, interthalamic (also: intermediate mass) 94 Ampulla, osseous, anterior 190, 193 – lateral 190 – posterior 185, 190 Angle of eye, lateral 204 – medial 204 Ansa cervicalis (Ansa hypoglossi) 268, 285 - subclavia (Ansa of Vieussens) 270, 275, 286 Antihelix 203 Antitragus 203 Antrum, mastoid 186 Anvil (incus) 185, 194 Aponeurosis, palatine 311

Aqueduct, cerebral (= Aqueduct of *Sylvius*) 117 Arachnoid of the brain 30

- of cerebellum 52

- of spinal cord 52, 53, 55, 294

Arch, glossopalatine 329

– pharyngopalatine 314

venous, jugular 272, 284Area cribiformis saccularis 193

subcallosal 92

 vestibular, superior of internal acoustic meatus 192

vestibular, inferior of internal acoustic meatus 192

Artery(-ies)

- angular 136, 140, 141, 210

alveolar, inferior 307

- - superior 307

- anterior communicating, of cerebrum 40, 41, 84, 85

auricular, posterior 186, 259, 262, 263

- basilar 58, 59, 60, 85

- buccal 308

- carotid, common 285, 300

- - external 19, 143, 300

Artery(-ies) carotid, common

- - internal 19, 41, 78, 81, 82, 84, 153, 299, 300

cerebellar, inferior, posterior 53,56

– superior 56

- cerebral, anterior 32, 33, 37–47

– middle 32–37

- - posterior 32, 33, 84, 85

- cervical, ascending 278

- - deep 246, 292

- - superficial 259, 282, 284, 286

ciliary, anterior 221posterior, long 221

- - - short 221

- ethmoidal, anterior 216

- facial 19, 136, 139–142, *143*, 262, 264, 307, 309

- infraorbital 209, 211, 307

- of labyrinth 184

laryngeal, superior 316

- lingual 159, 266, 270

– deep 267

- masseteric 308

maxillary (also: internal maxillary artery) 83, 142, 143, 144, 168, 263, 265, 307, 308, 310

meningeal,middle 19, 29, 78, 155, 305

- mental 165

- nasofrontal 212

occipital 50, 82, 138, 144, 270, 289, 305

- ophthalmic 84

palatine, ascending 155, 265, 267, 307, 311

– greater 311

– lesser 311

pharyngeal, ascending 305

- pterygoid, medial 304

- of pterygoid canal 155

- of retina, central 217

- spinal, anterior 297

Artery(-ies) spinal, anterior

– posterior 53

- sternocleidomastoid 284, 301

- stylomastoid 82, 305

subclavian 270, 278, 280, 283, 286

- sublingual 159, 167

- submental 266, 270

- supraorbital 215

- suprascapular 270, 282, 286

- supratrochlear 210

- temporal, deep 141, 307, 310

- - superficial 138, 262, 263

- thoracic, internal 270, 278

- - - left 277

- - - right 277

- - lateral 286

- thyroid inferior 280, 299

- - superior 259, 270, 272, 273,

278, 284, 300, 317

- transverse, of face 262, 265

- - of neck 270

- tympanic, posterior 187, 188

- vertebral 51, 52, 270, 296

zygomaticoorbital 210

Articulation, atlantoaxial, lateral 235

- atlantooccipital 235

Auditory tube (Eustach) 195

Body, amygdaloideum 119

- ciliary 227, 229

geniculate, lateral 116

- - medial 96, 116

- mamillary 91, 95

- pineal 94, 96

Brachium of inferior colliculus (also: posterior conjunctival brachium)

of superior colliculus (also: anterior conjunctival brachium) 96

Branch(es)

buccal, of facial nerve 139, 140, 262, 263, 266

Branch(es)

- cardiac, cervical (vagus nerve) 280
- digastric, of facial nerve 263, 267
- hyoid, of lingual artery 270
- marginal, mandibular, of facial nerve 139, 140, 262, 266, 284
- temporal, of facial nerve 139, 140
- temporofrontal, of facial nerve
 263
- thyroid, of hypoglossal nerve 285
- zygomatic, of facial nerve 139, 262, 263, 266

Bridge (Pons) 95

Bulb, olfactory 152

Bundle(s) (also: fascicle)

longitudinal, inferior 124

- - superior 124

Bursa, subhyoid 317

- pharyngeal 313

Canal, mandibular 171

- mental 171
- semicircular, anterior 188
- lateral 187
- posterior 188

Capsule, internal 120, 121

Cartilage of acoustic meatus 186

- cricoid 314
- thyroid 314

Caruncle, lacrimal 205

- sublingual 159

Cavity, tympanic 194

Cells, mastoid 186

Cerebellum 30, 33–35

Chiasm, optic 85, 91

Choanae 314

Chorda tympani nerve 155, 187, 305

Cistern, cerebellomedullary 52, 86

of chiasma (chiasmatic cistern) 86, 87

- interpeduncular 86

Cisterna ambiens 86

Clavicle (collar bone) 231

Cochlea 83, 189, 190

Colliculus, inferior 94, 96

- superior 91, 94, 96

Column, fornix 92, 94

Commissure, anterior, of cerebrum

92

- inferior 94
- posterior 96

Conchae, nasal 314

Condyle, occipital 233

Cone, elastic 321, 324

Confluence of sinuses 53

Conjunctiva, bulbar 205, 212

- palpebral 205

Cornea 226

Corpus callosum 37, 39–48, 56, 62, 63, 87, 91, 92, 93, 94, 109–121.

123, 128, 135

Crest, occipital, external 233

 transverse, of internal acoustic meatus 192

Crown, ciliary 227, 229

Crus cerebri 91

- of fornix 92
- of helix 203
- of incus, long 196

Cuneus 91, 92

Dens axis (odontoid process of axis) 233

Disc, ciliary 227, 229

Duct, endolymphatic 189

- Hensen's (ductus reuniens) 189
- lacrimal 206, 211
- nasolacrimal 206
- parotid 139, 162, 163, 264
- - lesser 163
- sublingual, greater 163
- submandibular 144, 159
- thoracic 280

Dura mater of brain 29, 31

Eminence of concha 186

Epiglottis 303

Esophagus 300

Eyelid (palpebrae) 204

Falx of cerebrum 37, 40, 48, 56, 89, 132, 135

132, 133

Fascia, cervical 259, 261

Fascicle (also:bundle)

- uncinate 124

Fenestrae of cochlea (also: round

window) 83, 193, 195

of vestibulum (also: oval window)190

Fibers, of pons, transverse 95

Fissure of cerebrum, longitudinal 90

Floccule 95

Fold, aryepiglottic 301, 314, 329

- glossoepiglottic, medial 329
- interarytenoid 314
- mallear, anterior 196
- posterior 196
- pharyngoepiglottic 314
- pterygomandibular 329
- salpingopalatine 314
- salpingopharyngeal 314
- ventricular 329
- vocal 329

Follicle, lingual 313

Foramen, condylar 233

- infraorbital 4, 231
- mastoid 232, 233
- mental 4, 231
- palatine, greater 311
- - lesser 311
- parietal 52

Fossa of antihelix 186

- of cerebrum, lateral 91
- infratemporal 232
- mandibular 232
- triangular, of auricle 186, 203

Frenum of tongue (frenulum of tongue) 157, 163

Ganglion(-ia)

- cervical, medial 285, 287
- superior 153
- cervicothoracic (stellate) 280, 287
- geniculate, of facial nerve 83, 183
- of glossopharyngeal nerve, inferior
 82, 83
- otic 82, 155, 304, 305
- pterygopalatine 83, 155
- spinal, of cervical nerves 2–8, 297
- second 51
- spiral, of cochlear nerve 185
- stellate (= ganglion, cervicothoracic)
- submandibular 167, 264, 266,
- 303, 304, 308, 310

 of sympathetic trunk, cervical, in-
- ferior 275
 - middle 275
- - cervical, superior 299, 300
- of trigeminal nerve 78, 80, 82
- of vagus nerve, inferior 155, 299, 300

Ganglion(-ia)

- - superior 155
- vestibular 184

Gingiva 172

Gland, lacrimal 206

- laryngeal, posterior 316
- lingual, anterior 163
- parathyroid, inferior 316
- - superior 316
- parotid 139, 162, 163, 262, 264
- - accessory 162, 163
- sublingual 144, 159, 162, 266
- submandibular 143, 144, 162, 264, 265

Granulations, arachnoidal 29–32 Groove of eyelid, inferior 204

- - superior 204

Gyrus(-i)

- angular 90
- cingulate 91
- fasciolaris 92
- frontal, middle 90
- superior 90
- occipital 90
- occipitotemporal, lateral 91
- - medial 91
- orbital 91
- parahippocampal 91
- precentral 90
- rectus 91
- supramarginal 90
- temporal, inferior 91

Hamulus, pterygoid 164

Head of malleus 187

- of stirrup 188

Helix 203

Hemisphere, cerebellar 53, 94

Hippocampus (Ammon's horn) 121

Horn of lateral ventricle, anterior

125

- - inferior 125
- – superior 125
- lesser, of hyoid bone 164

Hypophysis 40, 41, 58, 59, 70, 81

Incus 185, 194

Infundibulum cerebri 95

Iris 226

Isthmus of cingulate gyrus 91

- of thyroid gland 279

Lacuna, lateral, of superior sagittal sinus 29–32, 38, 39

Lamina affixa 94

- of hypothalamus, terminal 119
- of septum pellucidum 94
- spiral, bony 83
- superficial, of cervical fascia 273
- tectal 114

Lemniscus, lateral 114

Lens, crystalline 229, 230

Ligament, alar, of atlas 235

- of anvil (incus), posterior 194
- cricopharyngeal 315, 316
- cruciform, of atlas 235
- denticulate, of spinal cord 294
- flaval 235
- of incus, posterior 196
- longitudinal (vertebral column), anterior 256
- (vertebral column) posterior 235, 246, 288
- of malleus, lateral 194
- superior 194
- nuchae 256
- pterygospinal 239, 308
- sphenomandibular 233, 239, 302, 315
- stylohyoid 157, 164, 233, 235, 239, 266, 267, 315
- stylomandibular 153, 233, 235, 315
- supraspinous 246
- thyrohyoid 242, 243
- thyroid, lateral 315
- transverse, of atlas 235
- vocal 324

Line, nuchal inferior 233

– superior 233

Lobule, paracentral 92

- parietal, inferior 90
- - superior 90

Lymph node(s)

- - axillary 286
- buccal 22
- cervical, deep, inferior 271
- – superficial 271, 284
- - occipital 50, 271
- - parotid 22, 271
- - retroauricular 22, 271
- - submandibular, anterior 264
- - medial 264

Lymph node(s)

- – posterior 266
- – superior 264
- tracheal 317

Manubrium of malleus 194, 196

Mass, intermediate (= adhesion, in-

terthalamic) 94

Mastoid cells 186

- notch 187

Meatus, auditory, external 186, 194

Medulla oblongata 95

Membrane, stapedial 195

- tectorial 288
- thyroid 315
- tympanic 194, 196

Muscle(s)

- aryepiglottic 315
- arytenoid 315
- - oblique 316
- transverse 316
- auricular, posterior 265
- buccinator 9, 137, 156, 311
- constrictor m. of pharynx, inferior 300, 315
- - medial 300, 315
- -- superior 301, 302, 311
- cricoarytenoid, posterior 315
- cricopharyngeal 315
- cricothyroid 317
- digastric 154, 163, 242, 264
- genioglossus 157, 159, 257
- geniohyoid 157, 158, 162, 242,256, 257
- glossopharyngeal 311, 315
- hyoglossal 157, 159, 162
- hypopharyngeal 315
- iliocostal, of neck 288, 291
- intercostal, external 243
- - internal 243
- interspinal, of neck 246
- laryngopharyngeal 317
- levator, of head 243
- of palatine velum 152, 301, 311, 315
- - of pharynx 300, 301, 315
- - of scapula 283
- - of upper eyelid 206
- long, of head 244
- of neck 244
- longissimus, of head 290

Muscle(s) longissimus

- - of neck 290
- masseter 9, 140, 156, 163
- multifidus 291
- mylohyoid 158, 162, 242, 256
- mylopharyngeal 315
- oblique, of eyeball, inferior 208,214
- - superior 208
- - of head, inferior 245, 246
- superior 245, 246
- omohyoid 242, 243, 282, 307
- orbicular, of eye 136
- - of mouth 136
- palatoglossus 156, 311
- palatopharyngeal 152, 154, 156, 301, 302, 315
- pharyngoepiglottic 301, 315
- pharyngopalatine 153, 302
- pterygoid, lateral 302, 315
- - medial 153, 156, 158, 302, 304
- pterygopharyngeal 315
- scalene, anterior 242-244
- - middle 242-244, 288
- - posterior 242-244, 288, 297
- semispinal, of head 243, 245, 246, 290
- - of neck 246, 291
- serratus, posterior, superior 290
- splenius, of head 243, 283, 289, 290
- - of neck 283, 289
- salpingopharyngeal 152
- stapedius 188, 195
- sternocleidomastoid 242, 262
- sternohyoid 242, 243
- sternothyroid 242
- straight, of eyeball, inferior 208,
 226
- -- lateral 208. 226
- -- medial 208, 226
- -- superior 208, 226
- - of head, anterior 244
- - greater posterior 245, 246
- - lateral 244
- - lesser posterior 246
- styloglossus 156, 157, 242, 267, 304, 315
- stylohyoid 242, 265
- stylopharyngeal 153, 267, 302, 304, 315

Muscle(s)

- subclavius 242
- temporalis 9
- tensor, of palatine velum 157, 302
- - of tympanic membrane 194
- thyroarytenoid 318
- thyropharyngeal 315
- trapezius 242, 243, 283, 289
- of uvula 154, 302

Nerve(s)

- accessory (eleventh cranial nerve)82, 95, 144, 155, 282, 284, 294
- alveolar, inferior 142, 143, 155, 156, 168, 304, 307, 308
- - superior 307
- ampullar, posterior 185
- auricular, great 139, 259, 262, 274, 282, 284, 294
- - posterior 144, 186, 262, 263
- auriculotemporal 138, 155, 262, 263, 304, 308, 310
- buccal (buccinal) 141, 142, 156, 308, 319
- carotid, internal 153, 155, 299
- cervical, second 51, 53, 55
- cochlear 183
- cutaneous, of neck 259, 284
- ethmoidal, anterior 216
- facial 80, 82, 83, 187, 262, 263, 265, 266
- glossopharyngeal (ninth cranial nerve) 80, 82, 144, 267, 304, 305
- hypoglossal (twelfth cranial nerve)82, 95, 155, 159, 167, 168, 265,266, 267, 299, 317
- infraorbital 141, 209-211, 307
- infratrochlear 209, 210
- intermedial (intermediary) 80, 183
- jugular 155, 299
- lacrimal 210, 217
- laryngeal, recurrent 280
- - superior 278, 299, 316
- lingual (= lesser hypoglossal n.)
 141, 142, 143, 144, 153, 156, 159,
 167, 264, 266, 304, 308, 310, 311,
 317
- mandibular 21, 78, 82, 142, 143, 305, 308
- masseteric 141, 305, 308
- maxillary 21, 82, 83

Nerve(s)

- mental 156
- mylohyoid 141, 142
- nasal, anterior 152
- posterior 152
- nasociliary 217
- occipital, greater 50, 51, 138, 246
- - lesser 50, 259, 262, 282, 284, 294
- oculomotor 80, 81, 217
- olfactory, medial 152
- ophthalmic 82, 83
- superior 217
- optic 37, 40, 41, 57–60, 70, 78, 81, 82, 84–86, 135
- palatine, ascending 267
- - greater 156, 311
- - lesser 156, 311
- petrosal, deep 155
- - greater 83, 155, 183, 195
- - lesser 82, 195, 305
- phrenic 275, 279
- - accessory 286
- pterygoid, medial 304
- of pterygoid canal 83
- of retina, central 217
- subclavian 286
- sublingual 144, 167, 266, 310
- suboccipital 51, 292
- supraclavicular 285, 292
- - intermediate 259, 274, 282
- -lateral 259, 282
- medial 282
- supraorbital 209, 210, 215, 216
- suprascapular 282
- supratrochlear 209, 210
- temporal, deep 143, 307, 310
- transverse, of neck 259, 262, 263, 273, 282, 284, 294
- trigeminal (fifth cranial nerve) 78, 80, 81, 307
- trochlear 215
- tympanic (Jacobson's nerve) 195
- vagus (tenth cranial nerve) 21, 80, 82, 97, 153, 285, 286, 299
- vestibular 183, 184

Notch, mastoid 187

Nucleus, caudate 94, 107

- cuneate 56
- dentate, of cerebellum 114
- gracile 56

Nucleus

- lentiform 35, 36, 93, 107, 109–114
- red, of tegmentum 116
- subthalamic (Luys' body) 108

Obex 96

Olfactory bulb 39-41

- tract 39-41

Olive, inferior 95

Optic tract 78

Os, hyoid 231, 232, 239, 242, 243

Palate, hard 256, 257

- soft 257

Palpebrae 204

Peduncle, cerebral 95, 97

Platysma 259

Plexus, brachial 280, 283

- carotid 155, 268, 300
- external 268
- cervical 294
- parotid, of facial nerve 140, 265
- pharyngeal 153, 311
- pterygoid 141, 155
- tympanic (Jacobson) 82, 195
- venous, vertebral, internal 51, 292

Pole, frontal, of hemisphere 90

- occipital 90
- temporal 91

Pons 95

Precuneus (quadrate lobe) 92

Process(es)

- coracoid, of scapula 233
- mastoid 232
- pterygoid 239
- styloid 232
- vocal 329

Prominence, mallear 187

Protuberance, occipital, external 233

Pulvinar of thalamus 94, 96

Punctum lacrimale 205

Pupil 226

Pyramid 95

Radiation of corpus callosum 115

Raphe, pharyngeal 300

- pterygomandibular 309, 311

Recess, elliptical, of vestibule 190

- pharyngeal 313, 314
- piriform 301, 314

Recess

- spherical, of vestibule 190
- suprapineal 96

Roof of tympanum 188

Sac, endolymphatic 183

lacrimal 206, 211

Scala tympani 83, 193

- vestibuli 83, 193

Scapula 233

Sclera 205, 220

Septum, interalveolar 171

- intraalveolar 171
- pellucid 92

Sinus(es)

- carotid 300
- frontal 29, 145, 150
- maxillary 145, 150
- occipital 51
- petrosal, inferior 83
- superior 78
- sagittal superior 30–50, 37–40,
 - 51 53
- sigmoid 30, 33-37, 56, 70
- straight 43
- transverse 33–35, 37, 43, 46, 47,
- 51-54, 56

Space, preepiglottic 318

Squamous part of occipital bone 233

Stirrup (stapes) 82, 185

Stria, medullary, of thalamus 94, 115

- terminalis 94

Substance, black 117

- perforated, anterior 91
- - posterior 117

Sulcus(i)

- basilar, of pons 95, 97
- calcarine 91, 92
- central, of cerebrum (Sulcus
- Rolandi) 90
- of cingulum 90, 92
- collateral 91, 92
- frontal, inferior 90
- - superior 90
- hippocampal 91
- intraparietal 90
- lateral 90
- median 96
- occipitotemporal 91
- olfactory 91
- orbital 91

Sulcus(i)

- parietooccipital 90, 91
- parolfactory, anterior 92
- postcentral 90
- precentral 90
- subparietal 92
- temporal, inferior 91
- - superior 90

Surface, superior, of tongue 329

Tentorium of cerebellum 43

Thalamus 94

Tongue, superior surface 329

Tonsil of cerebellum 52, 53

- laryngeal 313
- lingual 313, 314
- palatine 303, 309, 311, 313, 314
- pharyngeal 303

Tract, corticospinal 120

- optic (ophthalmic) 97
- spinocerebellar, anterior 114
- - posterior 114
- spinotectal 114

Tragus 203

Triangle of Laimer 299

Trigone (triangle), olfactory 91

Trunk, brachiocephalic 280

- facial nerve 140
- thyrocervical 270, 277

Tube, auditory 314

Tuber cinereum 91, 95, 108 Tubercle, corniculate 314

- cuneiform 314

Umbo of tympanic membrane 188 Uvula of soft palate 311, 314

Vein(s)

- accompanying, of hypoglossal nerve 169, 265
- alveolar, inferior 169
- superior 307
- anastomotic superior 30
- angular 136, 139–141, 210
- auricular, posterior 260, 262, 28
- azygos 289
- brachiocephalic, left 278
- right 279
- buccal 308
- cava, superior 278, 279

Vein(s)

- cerebellar, inferior 53

- cerebral, inferior 32-35

- - middle 32-34

- - superior 30, 32–35, 37, 38

- cervical, deep 51, 246, 292, 294

- - subcutaneous 282

- - superficial 282

emissary, condylar 51, 246, 294

- - mastoid 246

- ethmoidal, anterior 216

- facial 20, 67, 136, 139–142, *143*, 169, 262, 264, 307

- jugular 277

- - anterior 264, 272, 284

- - external 20, 139, 259, 272, 284

- - internal 20, 67, 82, 83, 153, 285, 299

- of labyrinth 184

- laryngeal, superior 316

Vein(s)

- lingual 159, 167, 266, 267

- maxillary 265

- medial, of neck 274

- meningeal, middle 29

- nasofrontal 211, 212, 271

- occipital 51, 138, 289

- palatine, ascending 265

- retromandibular 67, 169, 262,

264, 271

- spinal, external, posterior 297

– posterior 53–55

- sublingual 266

- supraorbital 215

- suprascapular 282, 284

- temporal, deep 307

- - superficial 138, 262

- thalamostriate 94

- thoracic, internal 278

- - lateral 286

Vein(s)

- thyroid 272, 278

– inferior 299

- - medial 279

- - superior 279, 280, 317

- transverse, of face 265

- vertebral 278

- vorticose 217, 221

Velum, palatine 314

Ventricle, fifth (also: cavity of sep-

tum pellucidum) 94

- fourth, of cerebrum 118

- of larynx 329

- lateral, of cerebrum 121

- third, of cerebrum 94

Vermis, of cerebellum 128

Vestibule of mouth 172

Zonule, ciliary 227, 229